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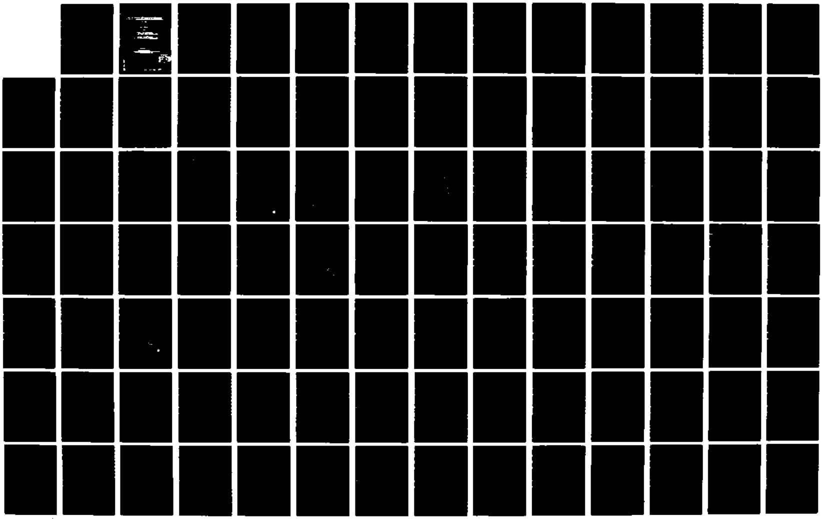

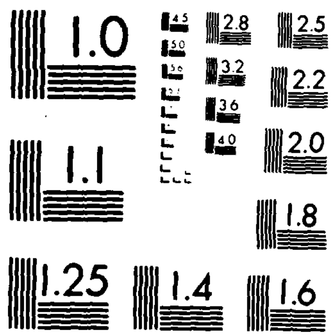


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# INSTALLATION RESTORATION PROGRAM
# PHASE II - CONFIRMATION/QUANTIFICATION
## STAGE I

FINAL REPORT

FOR

TYNDALL AIR FORCE BASE
TYNDALL AIR FORCE BASE, FLORIDA

TACTICAL AIR COMMAND
LANGLEY AIR FORCE BASE, VIRGINIA 23665

AUGUST 1984

PREPARED BY

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Phase IIb of the Installation Restoration Program for Tyndall AFB, Florida pertains to quantification and confirmation of potential contamination resulting from past hazardous waste disposal practices. Ten zones were investigated including four former landfill sites, four fuel storage areas, and two fire training areas.

Samples were collected from 31 shallow monitoring wells, two potable water wells, and a drainage ditch bisecting a former landfill. Samples were analyzed


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for various screening parameters [dissolved organic carbon (DOC), total organic halogens (TOX), total phenolics, oil and grease, pH, and specific conductance] and for specific constituents (metals, DDT, and purgeable organics).

Fuel contamination was present at the Highway 98 Fire Training Area, as indicated by visible oil sheens, strong fuel odors, and elevated volatile aromatics and total phenolics. Additional sampling will be required to determine the extent of contamination.

Results of TOX analyses were positive at all locations sampled and may reflect interferences due to inorganic chlorides. Total phenolics were detected at all locations sampled. Additional testing will be required to determine whether these positive screening results are due to natural conditions or contamination related to waste disposal. Metals and DDT were not detected in significant concentrations at any of the sampling locations.

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SUMMARY

# SUMMARY

## GENERAL

The Phase IIb Installation Restoration Program (IRP) Confirmation/Quantification Survey for Tyndall Air Force Base investigated 10 suspected hazardous waste disposal sites. These included four former landfill sites, four fuel storage areas, and two fire training areas. Site characteristics are summarized in Table S-1.

Shallow groundwater monitoring wells were installed either downgradient from or encircling nine of the sites. Four backhoe pits were excavated at the remaining site. Shallow groundwater from monitor wells and backhoe pits, potable water wells, surface water, and sediments were sampled for the parameters listed in Table S-2. Most of these analyses were screening tests [pH, specific conductance, dissolved organic carbon (DOC), total organic halogens (TOX), total phenolics, and oil and grease], which are nonspecific indicators of contamination. Samples were analyzed for specific constituents (cadmium, chromium, iron, nickel, lead, zinc, DDT, and purgeable organics) where prior information indicated they may be present.

Results of TOX screening analyses were positive at all sampling locations. It is suspected that inorganic chlorides in the shallow groundwater, present due to proximity to saline waters, created a positive interference in the TOX analysis. TOX in main base landfill (Zone 1) well Nos. T1-1, T1-2, T1-3; surface water location No. T1-SW3; and all sediment samples were high, ranging from 400 to 3,100 micrograms chloride per liter (ug Cl/l) for water and 3,400 to 5,200 micrograms chloride per kilogram (ug Cl/kg) dry weight for sediment. The sample from one well at Lynn Haven Defense Fuel Supply Point (DFSP) (Zone 2, well No. LH2-5) contained 320 ug Cl/l TOX. Additional testing will be required to verify the presence of positive chloride interference and/or organic halogen contamination.

Table S-1. Site Characteristics (Page 1 of 2)

| Phase I Records Search Site No. | Phase IIb Zone No. | Site Description | Period of Usage | Nearest Drinking Water Well (feet) | Nearest Surface Water Body (feet) | Depth to Groundwater (feet) | Evidence/Quantity of Hazardous Wastes | Suspected Hazardous Waste Types |
|---|---|---|---|---|---|---|---|---|
| 6 | 1 | Sewage Plant Vicinity Landfill | 1965–1973 | 2,400 | <500 | 0–10 | Known/small | Containerized waste, oils, and solvents |
| 7 | 1 | Spray Field Vicinity Landfill | 1973–1977 | 2,800 | <500 | 0–10 | Known/small | Containerized waste, oils, and solvents |
| 18 | 2 | Lynn Haven DFSP | 1943–present | 6,500 | <500 | 5–10 | Suspected/moderate | Sludge containing lead; Bunker C |
| 14 | 3 | POL Area "A" | 1943–present | <500 | <500 | 0–5 | Known/small | Sludge containing lead |
| A* | 4 | AAFES Service Station | 1948–1983 | 1,100 | 2,500 | 5–10 | Suspected/moderate | Gasoline |
| B* | 5 | Small Arms Repair Area | 1965–1972 | 750 | 1,000 | 5–10 | Suspected/moderate | Waste paints and solvents |
| 17 | 6 | Highway 98 Fire Training Area | 1952–1968 | 2,700 | 3,000 | 10–15 | None | Burning of POL waste |
| 4 | 7 | Southeast Runway Extension Burial Site | 1945–1965 | <500 | 5,000 | 0–10 | Suspected/small | Batteries, old parts, containers |
| 5 | 8 | "6000" Area Landfill | 1945–1965 | <500 | 1,500 | 5–10 | Suspected/small | Batteries, old parts, containers |

Table S-1. Site Characteristics (Page 2 of 2)

| Phase I Records Search Site No. | Phase IIb Zone No. | Site Description | Period of Usage | Nearest Drinking Water Well (feet) | Nearest Surface Water Body (feet) | Depth to Groundwater (feet) | Evidence/Quantity of Hazardous Wastes | Suspected Hazardous Waste Types |
|---|---|---|---|---|---|---|---|---|
| 15 | 9 | POL Area "B" | 1943-present | 3,300 | 5,500 | 10-15 | Suspected/small | Sludge containing lead |
| 16 | 10 | "Shell Bank" Fire Training Area | 1943-1952<br>1968-1980 | 2,000 | <500 | 0-5 | None | Burning of POL waste |

*These sites were discovered subsequent to the Phase I records search; site designations were made in Phase IIa presurvey.

Source: Hatch et al., 1981 (with updates).

Table S-2. Summary of Sampling and Analyses for Tyndall AFB Phase IIb Survey

| Zone No. | Site Description | Sample Location(s) | Sample Analyses |
|---|---|---|---|
| 1 | Main Base Landfills | Six monitor wells, one existing sewage spray-field well, four surface water samples from drainage ditch. | GWCI*, total phenolics, cadmium, chromium, iron, lead, nickel, zinc. |
| | | Three sediment samples from drainage ditch. | TOX, cadmium, chromium, iron, lead, nickel, zinc, and DDT. |
| 2 | Lynn Haven Defense Fuels Supply Point | Seven monitor wells. | GWCI, lead, oil and grease, presence of visible fuel layer. |
| 3 | POL Area "A" | Four monitor wells. | GWCI, lead, oil and grease. |
| | | Potable well within zone. | pH, specific conductance, purgeable organics. |
| 4 | AAFES Service Station | One monitor well. | Presence of visible fuel layer. |
| 5 | Small Arms Repair Area | Three monitor wells. | GWCI, chromium, lead. |
| 6 | Highway 98 Fire Training Area | Three monitor wells. | pH, specific conductance, DOC, total phenolics, lead, purgeable organics. |
| 7 | Southeast Runway Extension Burial Site | Three monitor wells, potable water well at adjacent alert facility. | pH, specific conductance, DOC, total phenolics, lead. |
| 8 | "6000" Area Landfill | Two monitor wells. | GWCI, total phenolics, chromium, lead, zinc. |
| 9 | POL Area "B" | Two monitor wells. | GWCI, lead. |
| 10 | Shell Bank Fire Training Area | Four backhoe pits. | GWCI, total phenolics, lead. |

*GWCI = Groundwater contamination indicators: pH, specific conductance, DOC, and TOX.

Total phenolic results for Zones 1, 6, 7, 8, and 10 ranged from 1 to 91 micrograms per liter (ug/l). With the exception of Zone 6 wells (range of 32 to 62 ug/l) and well No. T1-5 in Zone 1 (91 ug/l), all results for total phenolics were less than 20 ug/l. Additional testing for specific phenolic compounds will be required to determine whether these results are due to naturally-occurring phenolic compounds or contamination resulting from disposal at the site.

**HIGHWAY 98 FIRE TRAINING AREA, ZONE 6**

Monitoring wells within Zone 6 showed evidence of fuel contamination. Heavy oil sheens were observed on water seeping out of drill cuttings during well installation and a strong fuel odor was detectable in all three wells. The duplicate samples from well No. T6-3 contained significant concentrations of volatile aromatics (1,132 and 539 ug/l), again indicative of fuel contamination. Lead was either not detected or below drinking water maximum contaminant levels (MCLs) in monitor well samples from Zone 6, indicating that no significant lead contamination of shallow groundwater has occurred within the zone due to use of leaded fuels in fire training exercises.

**SOUTHEAST RUNWAY EXTENSION BURIAL SITE, ZONE 7**

Purgeable organics were detected at a total concentration of 132 ug/l in potable water well No. 11 at the alert facility adjacent to Zone 7. Total trihalomethanes (THMs) in this well equal the primary drinking water MCL of 100 ug/l established by the U.S. Environmental Protection Agency (EPA). Bromoform was the primary THM constituent (97 ug/l). Since bromoform is not a common constitutent of natural groundwater or of chemical wastes generated at Tyndall Air Force Base (AFB), these results must be confirmed by additional analyses. Specific conductance in well No. 11 was 1,090 micro mho per centimeter (umho/cm). Specific conductance is an indicator of total dissolved solids (TDS). The value reported for this well is high enough to indicate that the secondary drinking water MCL for TDS may be exceeded. High dissolved solids in well No. 11 is probably due to salt water intrusion rather than contamination from disposal practices.

In the three monitoring well samples within Zone 7 volatile aromatic (VOA) compounds were not detected, volatile organic halogens (VOH) were detected in low concentrations (18 to 31 ug/l), and lead was not detected. Elevated levels of DOC in well No. T7-1 and T7-3 (141 to 175 mg/l) are not believed to be caused by fuel contamination, due to the absence of VOA compounds in the samples.

**MAIN BASE LANDFILLS, ZONE 1**

TOX levels in samples from well Nos. T1-1, T1-2, and T1-3 and surface water location T1-SW3 were elevated, indicating the possibility of organic halogen contamination within Zone 1.

Analytical results for cadmium, chromium, nickel, lead, and zinc in samples from the main base landfills (Zone 1) indicate no significant contamination by these metals. All detected values in downgradient monitoring locations are below drinking water MCLs or other applicable criteria. Iron, though present in all Zone 1 samples in significant concentrations, does not present a contamination problem due to its low toxicity and rapid dilution anticipated in the adjacent Gulf of Mexico.

Total concentrations of DDT and its degradation products (collectively referred to as DDTR) in sediment samples taken from the drainage ditch dividing the two Zone 1 landfills ranged from 6.8 to 12.4 ug/kg dry weight. At these low concentrations it is unlikely that DDTR would be detectable in the overlying waters due to its low solubility and tendency to adsorb to sediments.

**FUEL FACILITIES, ZONES 2, 3, 4, and 9**

Potential contamination resulting from disposal of lead fuel tank sludges in shallow trenches at petroleum, oil, and lubricants (POL) storage areas A and B (Zones 3 and 9) and at Lynn Haven DFSP (Zone 2) was investigated. Lead analyses for shallow groundwaters within these zones indicate no significant contamination has occurred due to these disposal practices. Oil and grease analyses for Zones 2 and 3 monitor well

samples and observations noted during sampling indicate no significant fuel contamination in shallow groundwater due to spillage or overfilling of tanks.

Groundwater in Zone 4, the Army and Air Force Exchange Service (AAFES) Service Station, was sampled at a location downgradient from a leaking gasoline tank to determine whether the leaking tank has resulted in accumulation of fuel on the water table. Most of the leaking fuel is believed to have been collected and removed by the storm sewer system. No fuel was visible in water bailed from the well and no fuel odors were detected.

**OTHER LANDFILLS, ZONES 5 and 8**

Neither chromium nor lead were detected in three monitoring wells within Zone 5 (Small Arms Repair Area) and two monitoring wells within Zone 8 (6,000 Area Landfill), indicating disposal of paint residues or batteries at these sites has not resulted in significant contamination of shallow groundwater by these metals. Zinc was detected in both groundwater samples from Zone 8, but at levels well below the 5 milligrams per liter (mg/l) drinking water MCL.

**SHELL BANK FIRE TRAINING AREA, ZONE 10**

Lead was not detected in four backhoe pit water samples from Zone 10, indicating use of leaded fuels for fire training exercises in the zone has not resulted in significant lead contamination of shallow groundwater.

Table S-3 summarizes recommendations for follow-up work in the 10 zones, based on sampling and analyses summarized above.

Table S-3. Summary of Recommendations

| Zone | Sampling Location(s) | Recommended Analyses (Single Sampling): pH | Specific Conductance | TDS | TOX | Total Phenolics | DOC | Oil and Grease | Organic Scans: Purgeables VOA | Purgeables VOH | Acid Extractable | Base/Neutral Extractable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Wells Nos. T1-1, T1-3, T1-5, T1-6, and surface water location T1-SW3 | X | X | | X* | X* | | | X | X | X | X |
| 2 | Well Nos. LH2-1 and LH2-2 | X | X | | | | X | X | X | | | |
| 3 | None | | | | | | | | | | | |
| 4 | None | | | | | | | | | | | |
| 5 | T5-2 and T5-3 | X | X | | X* | X* | | | X | X | X | X |
| 6 | T6-1, T6-2, T6-3† | X | X | | X* | X* | X | X | X | X | X | X |
| 7 | T7-2, T7-3 | X | X | | X* | X* | | | X | X | X | X |
| | potable well No. 11 | X | X | X | X* | X* | | | X | X | X | X |
| 8 | T8-1 | X | X | | X* | X* | | | X | X | X | X |
| 9 | T9-1 | X | X | | | | X | X | X | | | |
| 10 | Install two monitoring wells between zone and adjacent water; screen top 5 feet of water table | X | X | | X* | X* | | | X | X | X | X |

*Optional.
†Recommendations for this site include removal and disposal of drums observed in wooded area southwest of site. Also two additional wells are to be installed between Zone 6 and potable water well No. 11, one screened throughout upper 10 to 15 feet of water table and the other through [illegible] the 20 to 30 [illegible] depth increment [illegible]

# 1.0 INTRODUCTION

# 1.0 INTRODUCTION

## 1.1 INSTALLATION RESTORATION PROGRAM BACKGROUND

This report describes Phase IIb of the IRP for Tyndall AFB, Florida. Phase IIb pertains to confirmation and quantification of suspected contamination at past hazardous waste disposal sites. Tyndall AFB is a Tactical Air Command (TAC) installation.

The United States Air Force (USAF), due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The primary federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of RCRA, federal agencies are directed to assist EPA, and under Section 3012 state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, Department of Defense (DOD) developed the IRP. The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by USAF message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate past disposal sites for potential hazardous waste contamination, and to control hazards to health and welfare that may have resulted from these past operations. The IRP will be the basis for response actions on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316.

The IRP is implemented in four phases. Phase I, Initial Assessment/ Records Search, is designed to identify possible hazardous waste contaminated sites and potential problems that may result in contaminant

migration from the installation. The Phase I report, completed for Tyndall AFB in December 1981 (Hatch et al., 1981), reviews the history of base operations and waste disposal practices, the geological and hydrogeological conditions which may affect contaminant migration and the ecological setting. All hazardous waste disposal sites identified in the Phase I report are ranked on the basis of a standard evaluation system [Hazardous Assessment Rating Methodology (HARM)], which is applied to all installation record searches.

Phase II, Confirmation and Quantification, is designed to confirm the presence and quantify the extent of contamination caused by migration of hazardous materials from present or abandoned waste disposal sites with HARM rankings indicative of significant environmental contamination. Phase II IRP studies are implemented in two or three parts. Phase IIa, completed for Tyndall AFB in January 1983 (WAR, 1983), consists of work plan development and costing of hydrogeological and chemical investigations. Phase IIb, described in this report, consists of field surveys, environmental sampling and analyses, data reduction and interpretation, and development of recommendations for remedial action and/or additional monitoring. Phase IIc, if necessary, provides additional monitoring data upon which design of mitigative actions are based. In Phase III, Technology Base Development, appropriate technology is selected and the engineering design of corrective action options selected for implementation by the USAF is completed. Phase IV, Operations/Remedial Action, involves construction, operation, and maintenance of the corrective action option designed under Phase III.

Water and Air Research, Inc. (WAR) is currently under contract with the USAF to provide geotechnical, field sampling, analytical, and engineering expertise in the implementation of Phase II surveys at selected USAF facilities. WAR's contract, number F33615-81-D-4007, has been in effect since July 20, 1981. On September 29, 1982 Order No. 0007 was issued under WAR's contract to initiate the Phase IIa presurvey at Tyndall AFB. This action was based on results of the Tyndall AFB Phase I survey and

HARM rankings of the sites investigated. Based on findings of the Phase I records search and Phase IIa presurvey, a scope of work was developed for the Tyndall AFB Phase IIb survey. Order No. 0011 was issued to WAR on August 30, 1983 to initiate this work.

## 1.2 FACILITY HISTORY

[NOTE: Information in this section is excerpted from the Tyndall AFB Phase I report (Hatch et al., 1981)].

Tyndall AFB (see Figure 1 for location) was activated in 1941 at the outset of World War II and became the center of the Army Air Corp's first flexible gunnery school. When World War II ended in 1945, Tyndall Field briefly operated on a standby status. In May 1946, it became the home of the University's Air Tactical School, training junior officers in the responsibilities of command at squadron level. The name of the installation was changed to Tyndall Air Force Base in 1947 when the Air Force became a separate branch ot the military service. In 1950, the base was transferred to the Air Training Command and became responsible for training all-weatner jet interceptor pilots (F-86D) and aircraft controllers. The aircraft controller school remains an important part of activities at the base, training hundreds of personnel to man radar scopes at aircraft control and warning stations around the world.

The base was transferred from the Air Training Command to the Air Defense Command in July 1957, when the F-86D interceptor school was transferred to Moody AFB, Georgia. At that time, Tyndall AFB's mission shifted to that of a weapons center. Its mission included four major areas: (1) weapons training and system evaluation; (2) testing of methods, tactics, techniques, and equipment; (3) tactical air defense; and (4) administering, equipping, training, and preparing subordinate units to accomplish their missions, in addition to providing support for all attached units in accordance with established Air Defense Command policies.

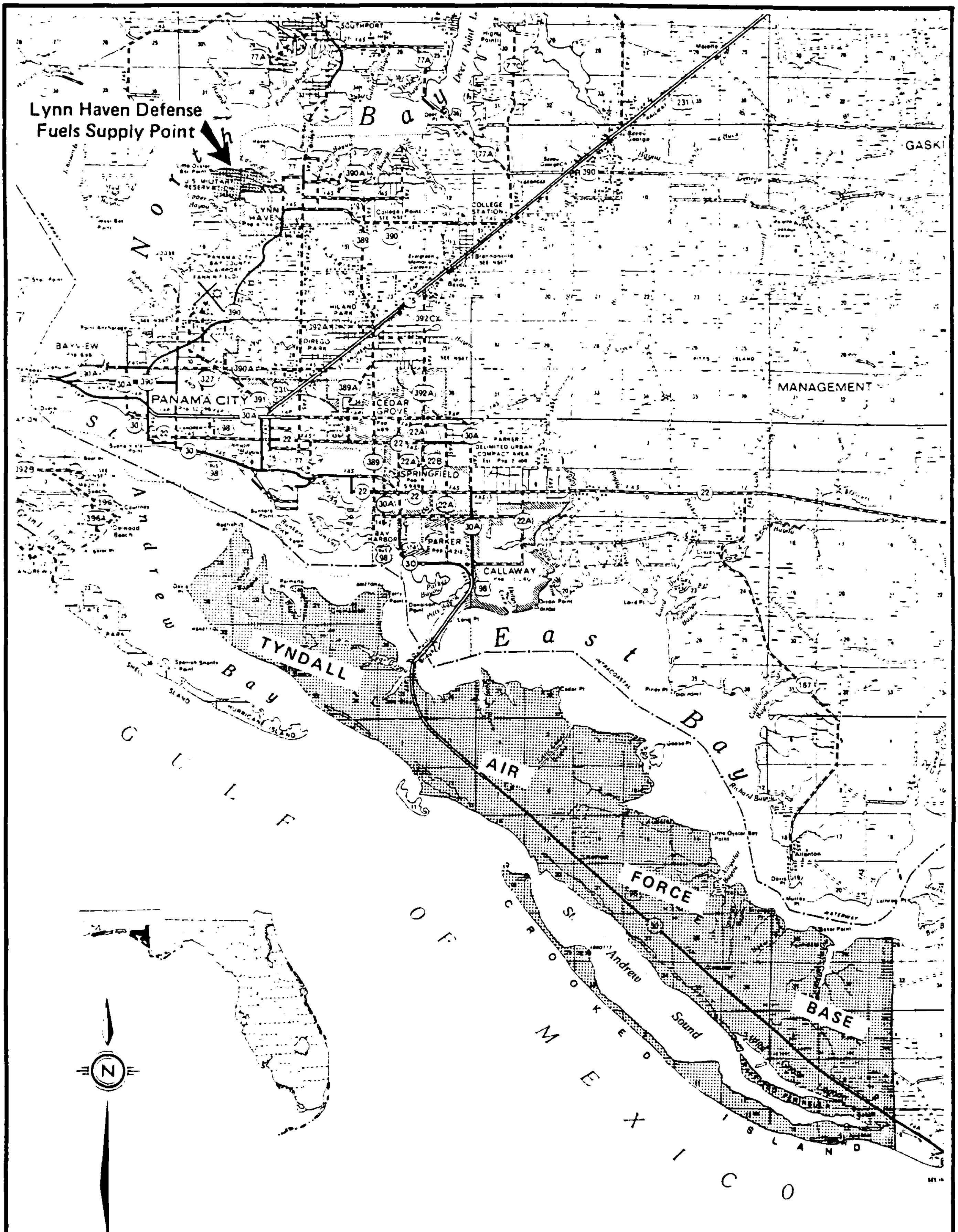



FIGURE 1. Location Map

SOURCE: Florida State Road Department, 1967.

Tyndall's role as a weapons center was broadened in 1962 with the assignment of a new mission for aircrew transition training for F-101 and F-106 pilots. To fulfill this new mission, the 4756th Air Defense Wing was activated. This was the result of a new Air Defense Command training mission, which gave the command the responsibility of providing combat training for its own interceptor aircrews, a task previously accomplished by the Air Training Command.

The USAF Air Defense Weapons Center was activated on January 1, 1968 to provide a single area within the DOD for the centralization of operational and technical expertise on air defense matters.

A new dimension to air defense weapons training was added to the weapons center's program on July 15, 1974, when the 62nd Fighter Interceptor Training Squadron/USAF Interceptor Weapons School conducted its first F-4 Air Defense Employment Course. This training was part of Project Worldwide Air Defense Enhancement, a program designed to significantly improve the air defense capabilities of aircrews assigned to the TAC, Alaskan Air Command, Air Forces Iceland, Pacific Air Force, and USAF-Europe.

On February 7, 1975, the USAF Air Defense Weapons Center assumed responsibility for a program designed to convert surplus F-102 aircraft into pilotless targets or "drones" that would accurately and economically simulate the fighter aircraft threat. A program is currently underway utilizing the F-100 fighter as an unmanned target system.

The USAF Air Defense Weapons Center and Tyndall AFB were made a part of TAC in October 1979. During that reorganization, TAC assumed the air defense responsibilities and added a Deputy Chief of Staff for Air Defense to command the newly acquired forces. On July 1, 1981, the 325th Fighter Weapons Wing was established under the center.

## 1.3 DISPOSAL SITE DESCRIPTIONS

A total of 18 sites were identified during the Phase I records search, nine of which were selected for Phase IIb confirmation. Two additional sites were discovered subsequent to the Phase I records search. A summary of these 11 disposal sites is given in Table 1. Site descriptions given in this section for sites identified during the Phase I records search are excerpted from the Phase I report (Hatch et al., 1981). Phase I site descriptions were updated, where necessary, to incorporate recent information. General locations of disposal sites are shown in Figure 2.

Site No. 4 (Zone 7), referred to as the Southeast Runway Extension Burial Site, was reported by one of the interviewees to have been used intermittently from 1945 to 1965 for disposal of used containers, drums, old batteries, and old parts (see Figures 2 and 3 for location). No information was found to indicate the quantity of material disposed of in this area, or if the drums and containers were empty. Apparently, the material was placed in narrow excavated trenches. Some of this material was encountered in borings made for construction of the southeast runway extension. Information on past industrial operations indicates that the industrial shops, which generate the majority of hazardous wastes such as chlorinated solvents, were not in operation during this time.

Site No. 5 (Zone 8), referred to as the "6000" Area Landfill, is located south of the pavements and grounds area of the base (Figures 2 and 4). A few interviewees indicated that old parts, batteries, and empty containers were dumped intermittently in this area from 1945 to 1965. Visual inspection of the site during the Phase I records search revealed a cleared area of approximately 3 acres covered with vegetation, indicative of former disturbed soil conditions which may have resulted from a landfill operation.

Site No. 6 (Zone 1), referred to as the Sewage Plant Vicinity Landfill, was the main sanitary landfill for Tyndall AFB from 1965 to 1973

Table 1. Site Characteristics (Page 1 of 2)

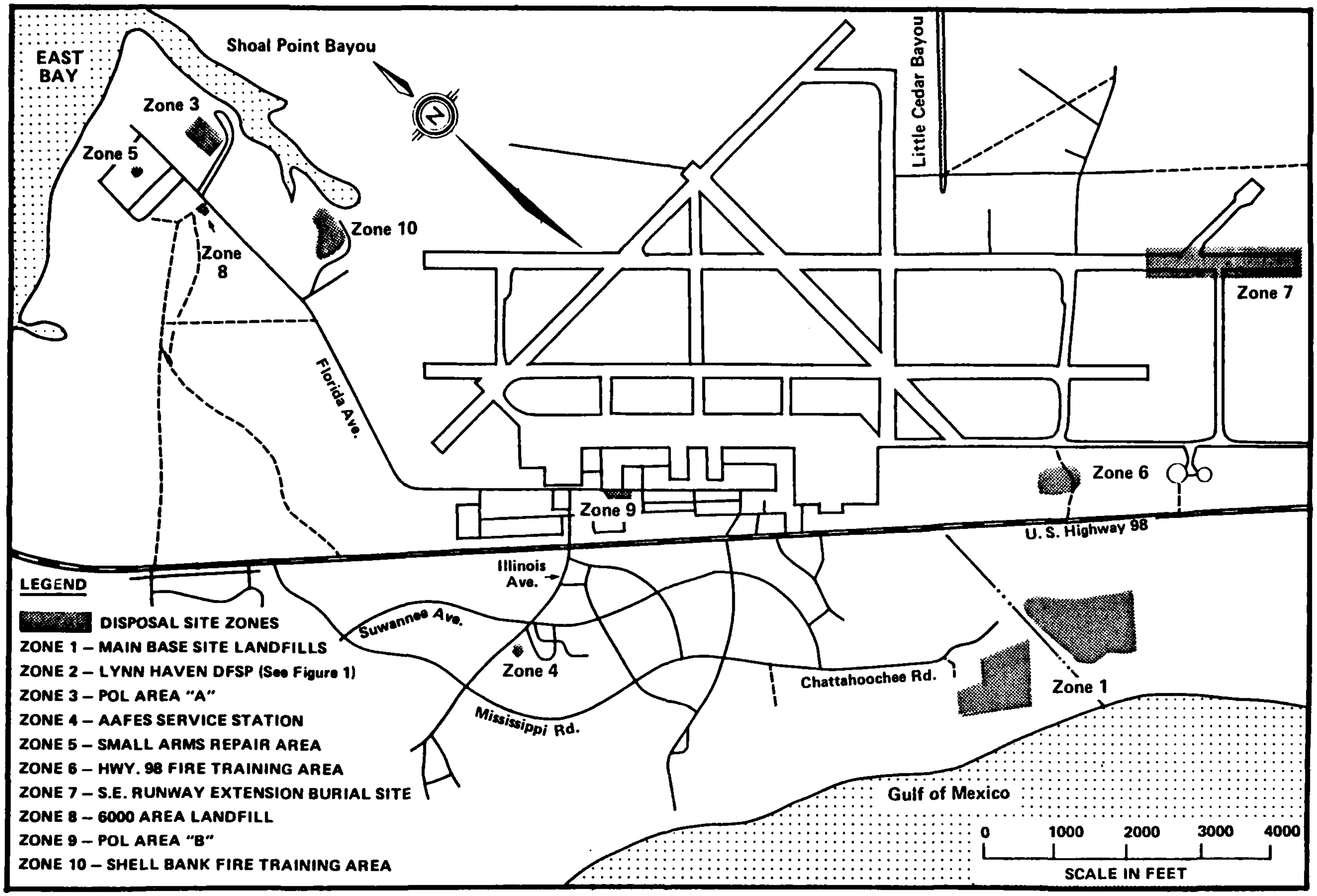
| Phase 1 Records Search Site No. | Phase IIb Zone No. | Site Description | Period of Usage | Nearest Drinking Water Well (feet) | Nearest Surface Water Body (feet) | Depth to Groundwater (feet) | Evidence/Quantity of Hazardous Wastes | Suspected Hazardous Waste Types |
|---|---|---|---|---|---|---|---|---|
| 6 | 1 | Sewage Plant Vicinity Landfill | 1965–1973 | 2,400 | <500 | 0–10 | Known/small | Containerized waste, oils, and solvents |
| 7 | 1 | Spray Field Vicinity Landfill | 1973–1977 | 2,800 | 500 | 0–10 | Known/small | Containerized waste, oils, and solvents |
| 16 | 2 | Lynn Haven DFSP | 1943–present | 6,500 | <500 | 5–10 | Suspected/moderate | Sludge containing lead; Bunker C |
| 14 | 3 | POL Area "A" | 1943–present | <500 | <500 | 0–5 | Known/small | Sludge containing lead |
| A* | 4 | AAFES Service Station | 1948–1983 | 1,100 | 2,500 | 5–10 | Suspected/moderate | Gasoline |
| B* | 5 | Small Arms Repair Area | 1965–1972† | 750 | 1,000 | 5–10 | Suspected/moderate | Waste paints and solvents |
| 17 | 6 | Highway 98 Fire Training Area | 1952–1968 | 2,700 | 3,000 | 10–15 | None | Burning of POL waste |
| 4 | 7 | Southeast Runway Extension Burial Site | 1945–1965 | <500 | 5,000 | 0–10 | Suspected/small | Batteries, old parts, containers |
| 5 | 8 | "6000" Area Landfill | 1945–1965 | <500 | 1,500 | 5–10 | Suspected/small | Batteries, old parts, containers |

Table 1. Site Characteristics (Page 2 of 2)

| Phase I Records Search Site No. | Phase IIb Zone No. | Site Description | Period of Usage | Nearest Drinking Water Well (feet) | Nearest Surface Water Body (feet) | Depth to Groundwater (feet) | Evidence/Quantity of Hazardous Wastes | Suspected Hazardous Waste Types |
|---|---|---|---|---|---|---|---|---|
| 15 | 9 | POL Area "B" | 1943-present | 3,300 | 5,500 | 10-15 | Suspected/small | Sludge containing lead |
| 16 | 10 | "Shell Bank" Fire Training Area | 1943-1952<br>1968-1980 | 2,000 | <500 | 0-5 | None | Burning of POL waste |

*These sites were discovered subsequent to the Phase I records search; site designations were made in Phase IIa presurvey.
†Site may have been used prior to this period, though this could not be verified in interviews with base personnel.

Source: Hatch et al., 1981 (with updates).




SOURCE: WAR, 1984.

FIGURE 2. Tyndall AFB Disposal Site Locations

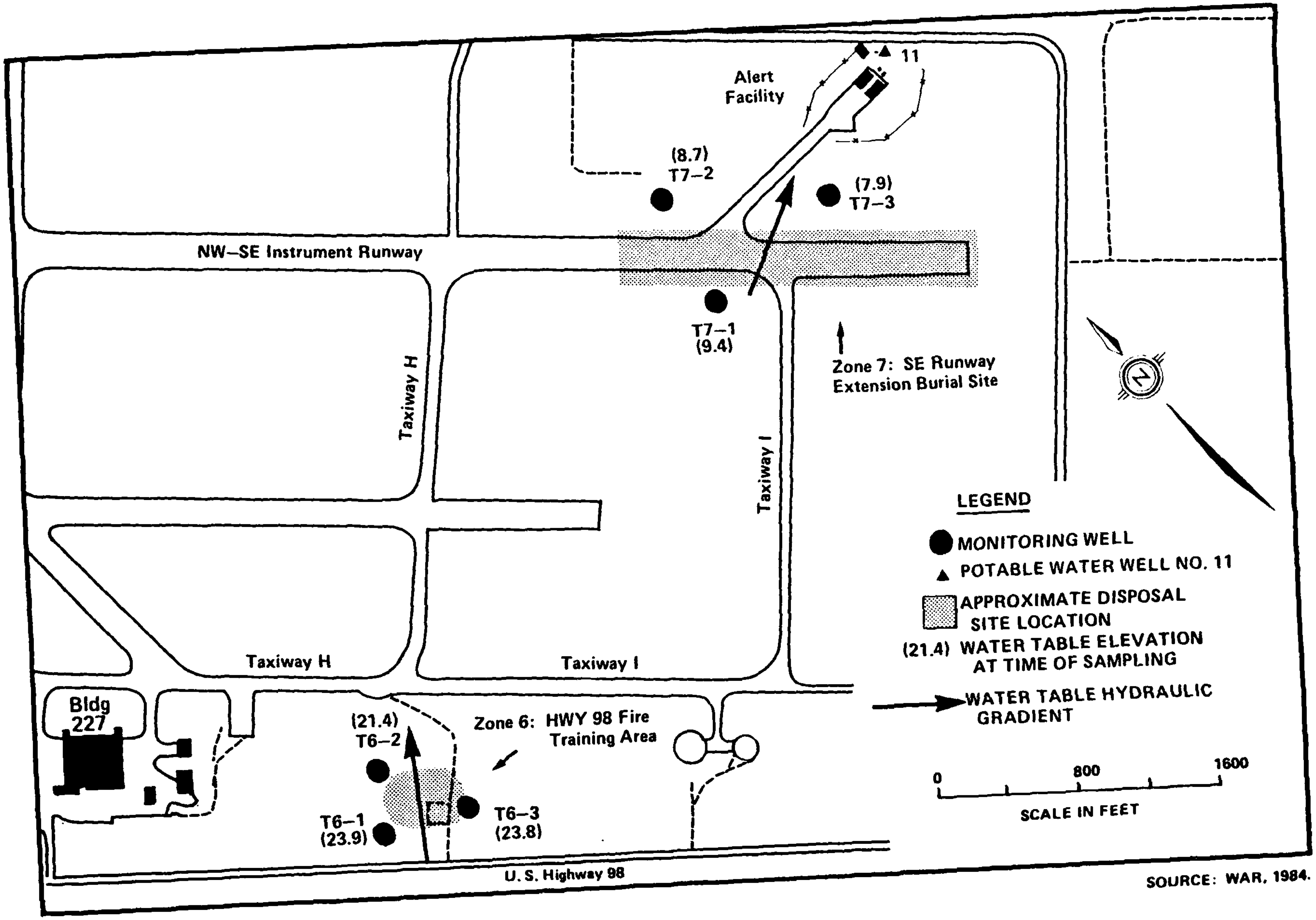
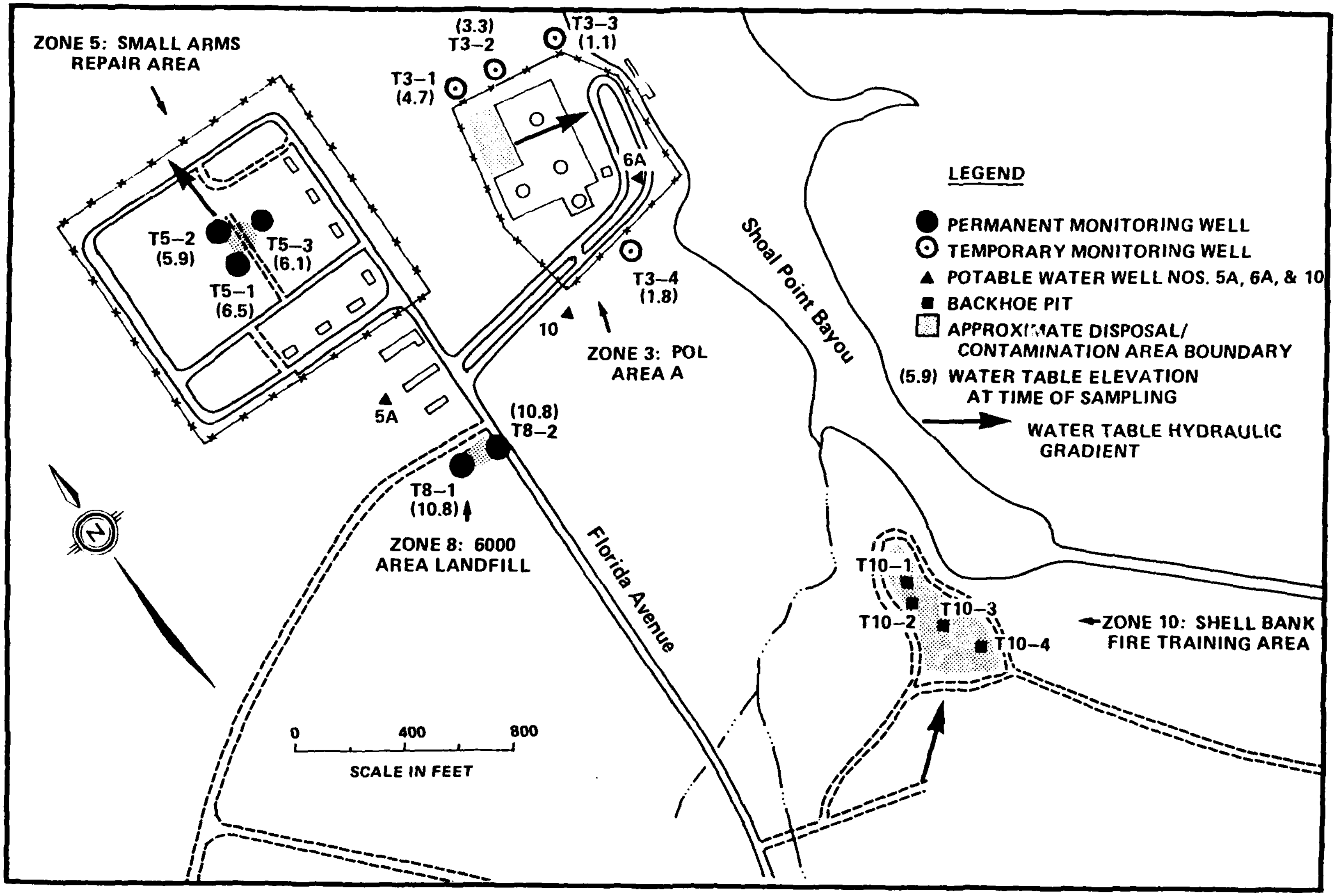



FIGURE 3. Site Map for Zones 6 and 7



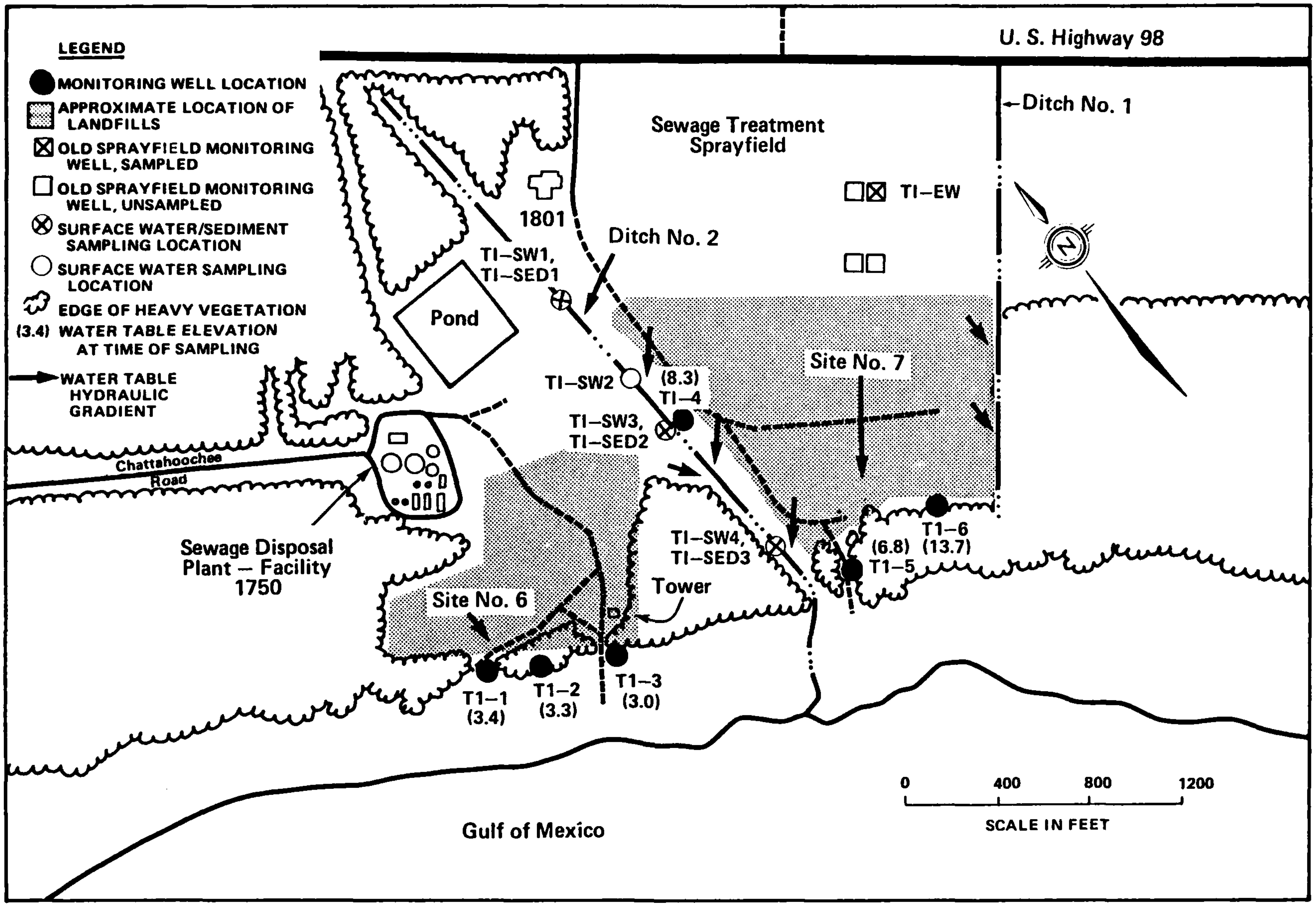

SOURCE: WAR, 1984.

FIGURE 4. Site Map for Zones 3, 5, 8, and 10

Figures 2 and 5). The site was also used intermittently after 1973 for disposal of construction rubble. Several interviewees indicated during the Phase I records search that unauthorized dumping of containers and drums containing waste oils and solvents occurred there in the past.

Other materials buried included wrecked drones and some asbestos encased in concrete. Since the total hazardous waste quantities generated from industrial activities is small and landfill disposal was never the standard procedure for disposal of these wastes, this landfill is designated as a site where known small quantities of hazardous wastes were disposed of in the past. Based on the types of industrial operations, these wastes may have included sealed containers of methyl ethyl ketone, paint residues and thinners, cresylic acid, o-dichlorobenzene, phenolic paint strippers, trichloroethylene, and chromic acid cleaning solutions.

Site No. 7 (Zone 1), referred to as the Spray Field Vicinity Landfill, was the main base sanitary landfill for Tyndall AFB from 1973 to 1977 and is located downgradient from the existing wastewater spray irrigation field (Figures 2 and 5). As with site No. 6, this sanitary landfill was a trench/fill operation where solid waste from the base was placed and compacted in excavated trenches. Some interviewees in the Phase I records search indicated that trenches were often excavated below the groundwater table and that refuse was dumped into standing water. Compacted solid waste received a daily 6-inch cover of compacted soil from the excavation process. The final cap for the landfill totals 3.5 feet of soil and is planted with grass for erosion control. As with site No. 6, several of the records search interviewees indicated that unauthorized dumping of containers and drums took place in the past. Since the total quantities of hazardous wastes generated from industrial activities at Tyndall AFB is small, this landfill is designated as a site where known small quantities of hazardous wastes were disposed of in the past. Based on the types of industrial operations, these wastes may have included sealed containers of methyl ethyl ketone, paint residue and




SOURCE: WAR, 1984.

FIGURE 5. Zone 1, Main Base Landfills

thinners, cresylic acid, o-dichlorobenzene, trichloroethylene, tetrachloroethylene, and chromic acid cleaning solutions.

A ground tour of site Nos. 6 and 7 conducted by the Phase I contractor showed that these sites have been closed and are now covered with vegetation that is typical of that growing in disturbed soil conditions resulting from past landfill operations. Many small pine trees were observed growing at site No. 7. Both areas were fenced and posted with signs prohibiting dumping in these areas. Two drainage ditches run through these areas; one drainage ditch (referred to as ditch No. 1) borders site No. 7 at its southern extremity, while the other drainage ditch (referred to as ditch No. 2) forms a boundary dividing site Nos. 6 and 7. Both drainage ditches flow into the Gulf of Mexico. The Phase I ground tour was taken after a night of heavy rainfall. Visual inspection of ditch No. 1 showed a small flow of water with good visual quality. The majority of this flow probably originated from runoff/percolation from the upgradient spray irrigation site. Visual inspection of ditch No. 2 showed a much larger flow than in ditch No. 1. The sides and bottom of ditch No. 2 contained an orange/brown sediment, typical of iron or iron bacteria deposits resulting from landfill leachate. Visual quality of the water column itself was good. The orange/brown sediment was evident in the ditch along the entire extent of the landfill, and was absent in that portion of the ditch upgradient of the landfills, providing further indication of leachate migration from site Nos. 6 and 7 as the source.

Site No. 14 (Zone 3), referred to as POL Area "A", is located at the tank farm near the Shoal Point Bayou barge unloading facilities (Figures 2 and 4). Small quantities of residues from tank sludge removal operations have been routinely disposed of in shallow trenches at this site since 1943. This procedure was considered to be an acceptable disposal method. Prior to 1974, however, leaded aviation gasoline (avgas) was commonly stored at the POL Area "A" tank farm, and residue from cleaning avgas storage tanks would have contained lead. In some instances, leaded tank bottoms from

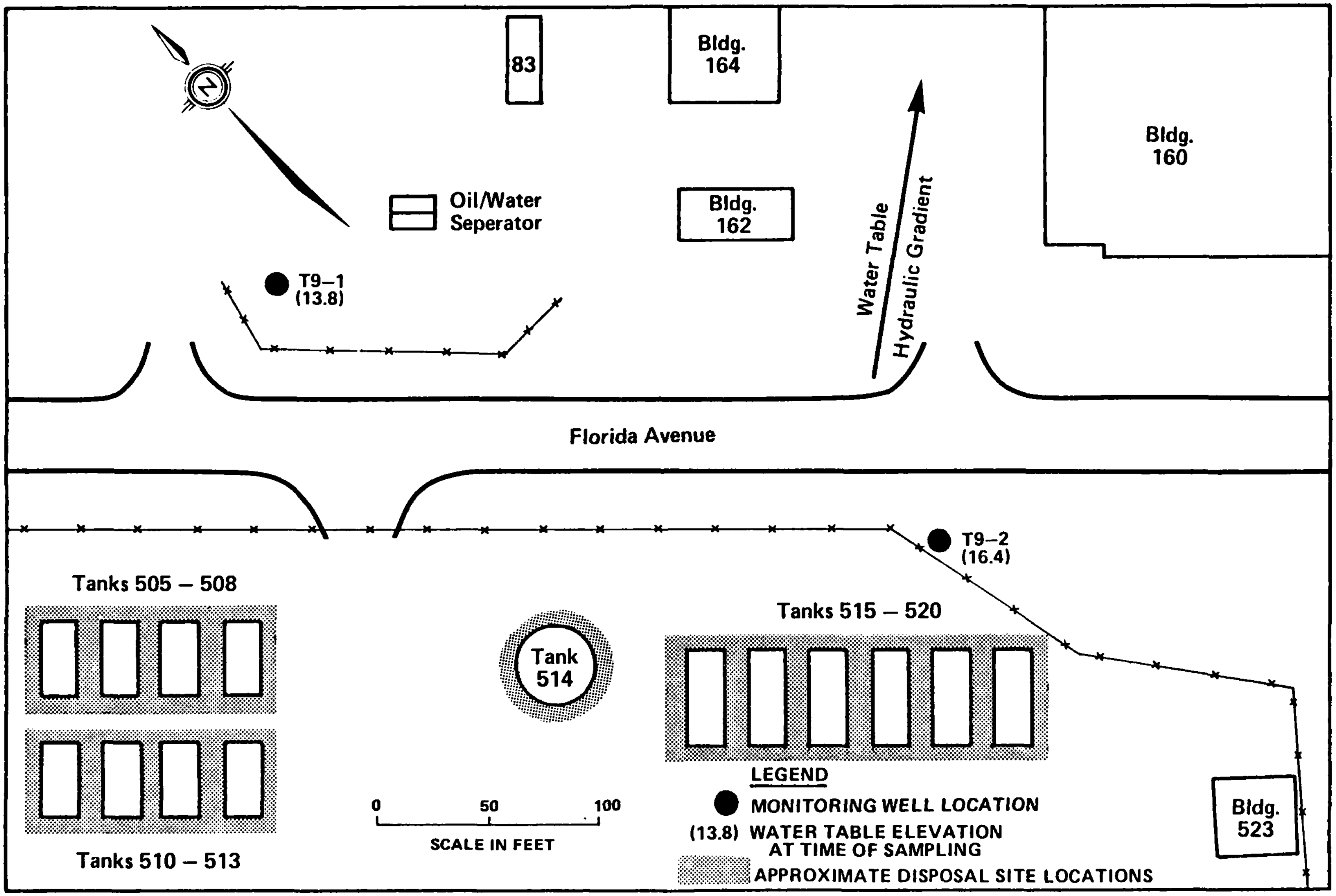
sludge removal operations are considered to be RCRA hazardous wastes (EPA Hazardous Waste No. K052). Although total waste quantities are believed to be small, the possibility does exist for leaching of lead from this site into area groundwater. No fuel saturation problems at this area are known or suspected.

Site No. 15 (Zone 9), referred to as POL Area "B", is located in the flight line area of the base near the Area "500" tank farm (Figures 2 and 6). The same concerns for lead migration into area groundwaters exist for site No. 15 as for site No. 14. Since the POL Area "B" tank farm is a much smaller operation, total sludge quantities disposed of at this site would be much smaller than at site No. 14. No fuel saturation problems in this area are known or suspected.

Site No. 16 (Zone 10), referred to as the "Shell Bank" fire training area, was the original fire training area and is located northwest of the main instrument runway near Shoal Point Bayou (Figures 2 and 4). This site was used from 1943 to 1952, and again from 1968 to 1980.

Site No. 17 (Zone 6), referred to as the Highway 98 fire training area, was used from 1952 to 1966, and was located between the power check pads (Facility 84) and Highway 98 (Figures 2 and 3). Site No. 17 is also referred to as Site D, Drum Disposal Area, in the Phase IIa presurvey and Phase IIb scope of work. It was reported by one of the interviewees that 300 empty drums were crushed and buried approximately 300 feet east of this site in 1968. Standard procedure was to transport all empty drums to DPDO for salvage.

Site Nos. 16 and 17 were the main repositories for POL waste from industrial operations at Tyndall AFB in the past. POL waste was transported to these areas and deposited in 20,000-gallon storage tanks. The POL waste was then sold to contractors or used in fire training exercises. Standard procedure for the fire training exercises was to pour POL waste onto an old aircraft or simulated aircraft located in a



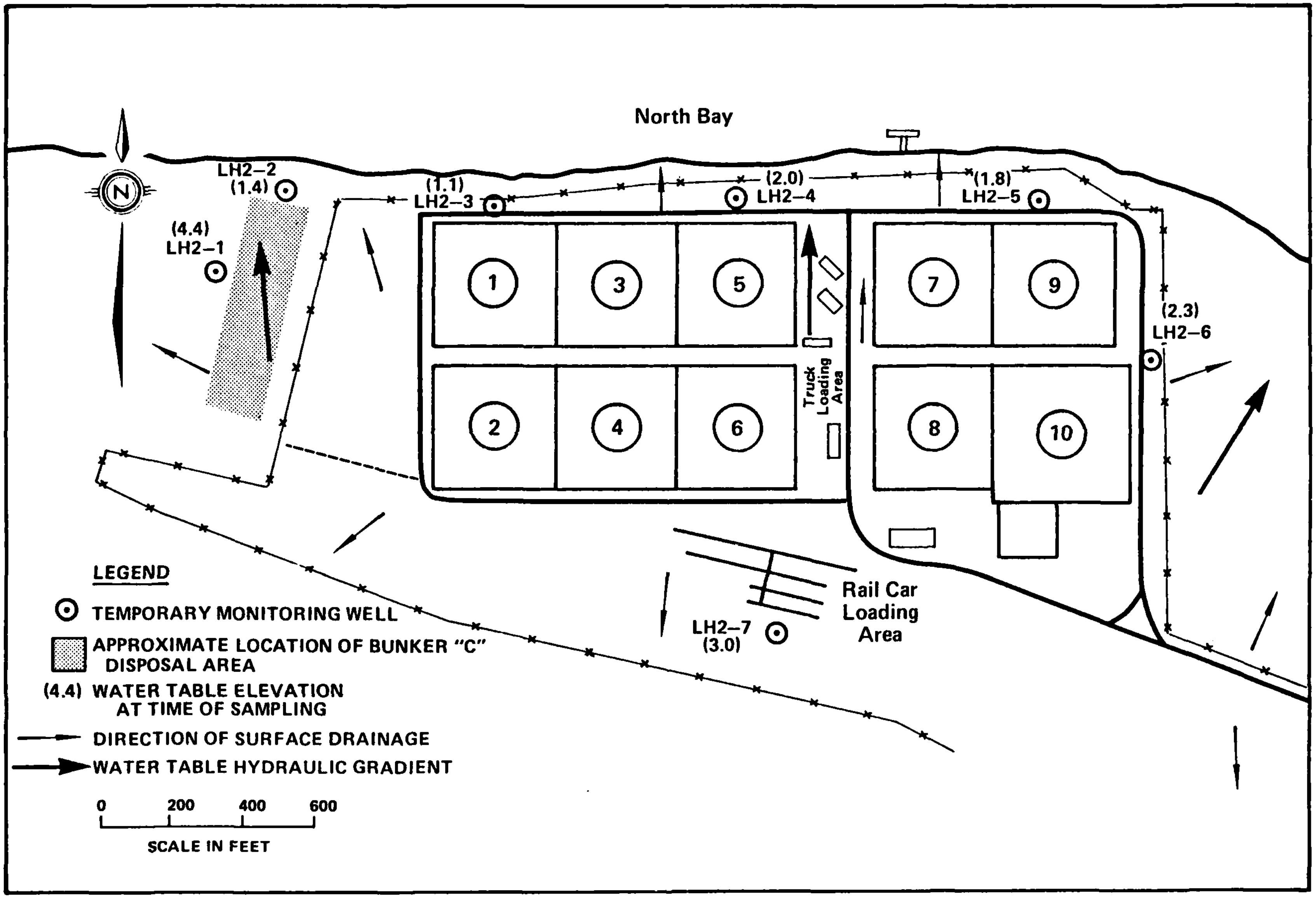

SOURCE: WAR, 1984.

FIGURE 6. Zone 9, POL Area "B"

bermed area, and then set the aircraft on fire. Most of the POL waste was consumed in the fire; however, some minor percolation into the groundwater may have taken place. It was reported by one interviewee that POL waste was sometimes taken to fire training areas by flight line personnel and dumped into the bermed training area instead of the POL waste storage tank. Additional quantities of POL waste may have entered the groundwater by this unauthorized practice, although total quantities are believed to be small. Prior to 1971, a protein foam was used to put out the fires. Since then, fire-fighting agents known as aqueous film forming foams (AFFFs) have been used. AFFFs are noncorrosive and consist of fluorocarbon surfactants with petroleum base foam stabilizers. Small quantities of AFFFs may have percolated into the ground during fire-fighting exercises.

Site No. 18 (Zone 2), the Lynn Haven DFSP, is located on 203.44 acres next to North Bay (Figures 1 and 7). This facility has been used as a bulk fuels storage and dispensing terminal since 1943. Although the property is owned by Tyndall AFB, the facility was acquired by the Defense Fuel Supply Center in 1973 and is operated by a private contractor. Originally, the facility was operated by the U.S. Navy for storage of Bunker C fuel. Fuel was unloaded from tankers moored at four docks at the north end of the site and stored in 10 steel tanks which are still present at the facility. Fuel was then transferred to railroad tank cars for shipment throughout Florida and the southeast. A railcar maintenance facility was located in the southeast corner of the site, but was demolished in the early 1950s; only the floor slab remains.

A drum loading station was originally present south of the railcar loading area, and was used for loading drums filled with Bunker C fuel onto trucks for shipment. Steam, which was generated at that time for increasing the fluidity of Bunker C fuel, was also used for cleaning waste drums. The steam-cleaned oil was routinely dumped on the ground behind the drum loading station, evidence of which can still be seen.



SOURCE: WAR, 1984.

FIGURE 7. Zone 2, Lynn Haven Defense Fuels Supply Point

In the early 1950s, Bunker C fuel was phased out of use. One of the interviewees reported that when the Bunker C fuel became obsolete, the fuel remaining in the bulk storage tanks was pumped out on the ground outside of the west gate. Moderate quantities may have been disposed of in this way. A thin layer of black, weathered sludge was observed in shallow pits in that area during a ground tour of the facility conducted by the Phase I contractor. A few abandoned drums and used fuel filter cartridges among other trash was also noted. Most of the area, approximately 1 acre in size, is covered with vegetation indicative of former disturbed soil conditions which may have resulted from a landfill operation. Some distressed willow trees were observed growing in the waste disposal pits.

Since the 1950s, avgas, JP-4, and JP-5 have been the primary fuels stored at the facility. Prior to 1969, it was common practice to bury tank sludges within diked areas surrounding the storage tanks. Bottoms of the dike areas are extremely permeable, consisting of a sand base with a gravel cover. Locations and quantities of buried material were not recorded, and the wastes were not characterized. Some of the sludge was from leaded fuel. Leachate migration has reportedly not been observed or monitored, and most of the buried material is believed to have been removed during regrading and resurfacing of the terminal grounds.

Reports of minor spills have been common. Periodically, tanks are overtopped, spilling approximately 5,000 gallons every 1 or 2 years. Minor spills have also occurred at the existing truck loading station and the railcar loading area. Measures to mitigate the effects of spills were undertaken in the late 1970s. An underdrain field was installed in 1980 beneath the railcar loading area as a spill mitigation measure. The underdrains, which discharge to a series of oil/water separators, have collected Bunker C fuel from groundwater underlying the railcar loading area.

The facility currently operates six oil/water separators and has a National Pollutant Discharge Elimination System (NPDES) permit for six

stormwater discharges to North Bay. These discharges are routinely sampled by the contractor operating the facility and are analyzed for oil and grease, suspended solids, biochemical oxygen demand (BOD), pH, lead, and chromium. Limits for these parameters established by the NPDES permit have not been exceeded with the exception of one oil and grease value of 6.1 mg/l reported for January 1983. A resampling to confirm this value indicated oil and grease below the detection limit of 1 mg/l.

Site A (Zone 4), the AAFES Service Station (Bldg. 968), is located on Illinois Avenue in front of the base exchange (Figures 2 and 8). A leak from a gasoline storage tank has resulted in fuel infiltrating into nearby storm sewers. The tanks were installed when the service station was originally constructed in 1946, but the period of leakage is unknown. Fuel contamination may still be present in shallow groundwater in the vicinity. The leaking fuel tank was removed with the installation of new tanks in 1983. Site A was discovered subsequent to the Phase I records search.

Site B (Zone 5), the Small Arms Repair Area, is located in an open field in the "6000" area (Figures 2 and 4). This site was discovered in conversations with base personnel subsequent to the Phase I records search. Significant amounts of waste paints and solvents were reported to have been disposed of in an open pit. Base personnel indicated that the site was utilized between 1965 and 1972, though some usage may have occurred prior to that period.

## 1.4 PROJECT STAFF

Key personnel participating in the Tyndall AFB Phase IIb survey are listed below. Resumes of the project staff are included as Appendix G.

J.H. Sullivan, Ph.D., P.E., Environmental Engineer: Project Manager.
J.A. Steinberg, Ph.D., P.E., Water Resources Engineer.
W.G. Thiess, M.S., Environmental Engineer.
W.D. Adams, M.S., Hydrogeologist.
C.R. Fellows, M.S., Chemist.
R.D. Baker, Chemist.

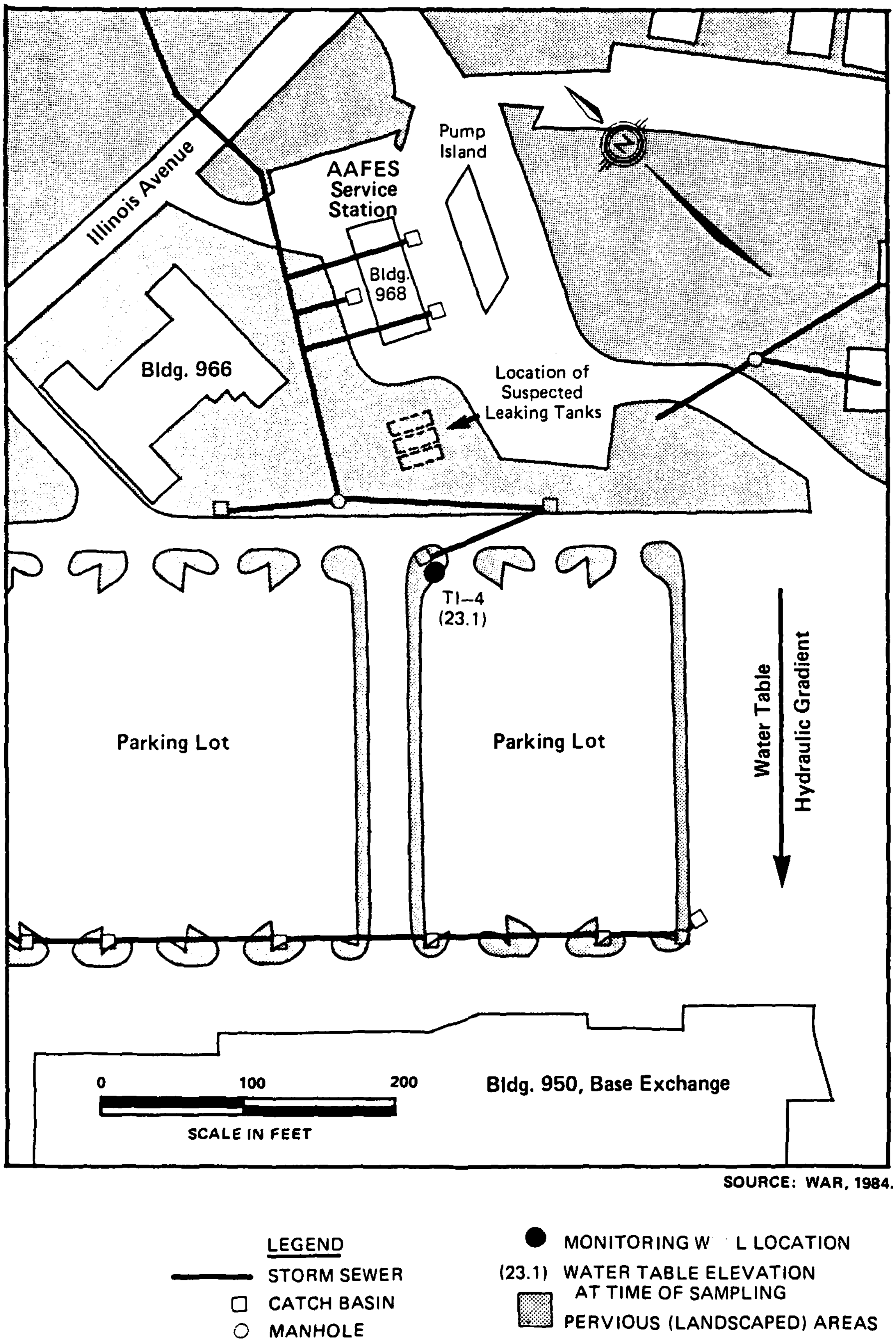



**FIGURE 8. Zone 4, AAFES Service Station**

## 2.0 ENVIRONMENTAL SETTING

## 2.0 ENVIRONMENTAL SETTING

[NOTE: Descriptions given in this section are excerpted from the Phase I records search (Hatch et al., 1981)]

### 2.1 METEOROLOGY

Located near 30° north latitude, Tyndall AFB is within a belt of high pressure known as the "horse latitudes." The climate of this region shares aspects of northern temperate latitutdes and southern semitropical latitudes. Warm, humid semitropical conditions are prevalent for approximately half of the year with convective storms and hurricanes playing a dominant role in weather patterns. During the winter season, occasional cold fronts break through from temperate latitudes, bringing winter rains and occasional freezing temperatures.

The annual average temperature at Tyndall AFB is 69°F with an average daily maximum and minimum of 77°F and 61°F, respectively. The Gulf of Mexico, with an average annual water temperature of 73°F, has a stabilizing effect on the climate of the base and contributes to the high relative humidity, which averages 75 percent.

Tyndall AFB has an average annual rainfall of 55.2 inches, with 125 days of recordable precipitation during the year. Greatest rainfall occurs between June and September, with other smaller peaks in December and March. Most thunderstorm activity occurs during the months of June, July, and August. Lake evaporation is about 50 inches per year and is an approximation of evapotranspiration in the area. Actual evapotranspiration rates over land areas may be greater or less than this value, depending on vegetative cover type.

Surface wind speeds are generally weak, with highest average winds (12 knots) occurring in March and lowest values occurring during the summer months (7 knots). Peak winds as high as 69 knots have been recorded at the Tyndall AFB flight line. The beaches were buffeted by winds up to 100 knots during the passage of hurricane Eloise in 1975.

## 2.2 GEOLOGY

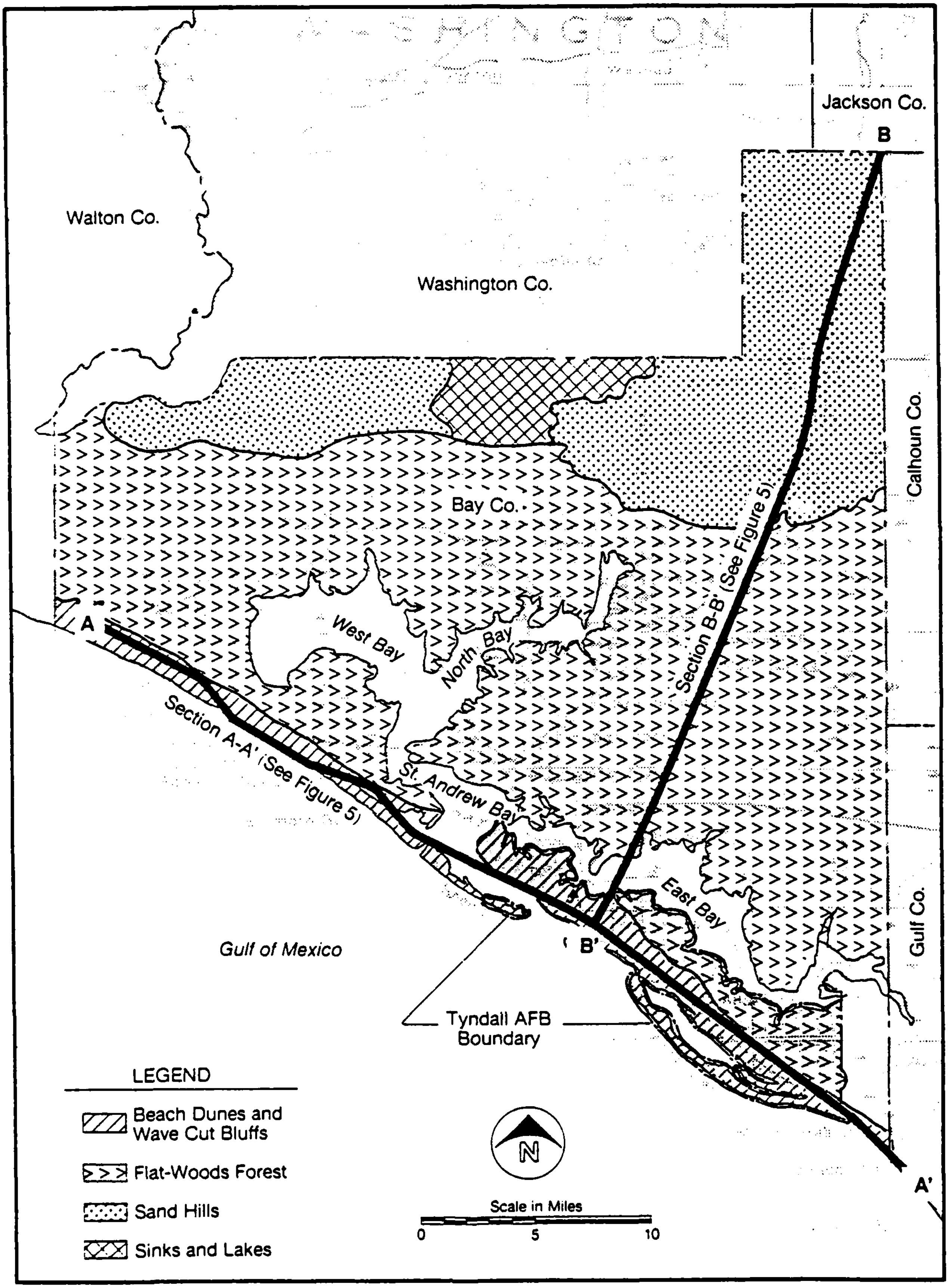
Tyndall AFB is located on a peninsula that extends along the shoreline of the Gulf of Mexico. The highest ground on the peninsula is 20 to 30 feet above mean sea level (msl) and occurs along a ridge located approximately 3,000 feet north of the St. Andrew Sound shoreline. Highway 98 runs along the crest of this ridge.

In general, areas on the northeast side of the ridge belong to the "flatwoods forest" physiographic subdivision. The ground surface in this area is nearly flat and covered with pine trees. Surficial soils are sandy yet poorly drained. Close to the bay, there are some low-lying areas that are frequently inundated by heavy rains.

Areas on the southwest side of the coastal ridge belong to the "beach dunes and wave-cut bluffs" physiographic subdivision. Surface features prevalent within this subdivision include estuaries, lagoons, spits, barrier islands, and sand dunes. Crooked Island, a sand spit which separates St. Andrew Sound from the Gulf of Mexico, is characteristic of this subdivision. The approximate limits of physiographic subdivisions in the area of Tyndall AFB are shown on Figure 9.

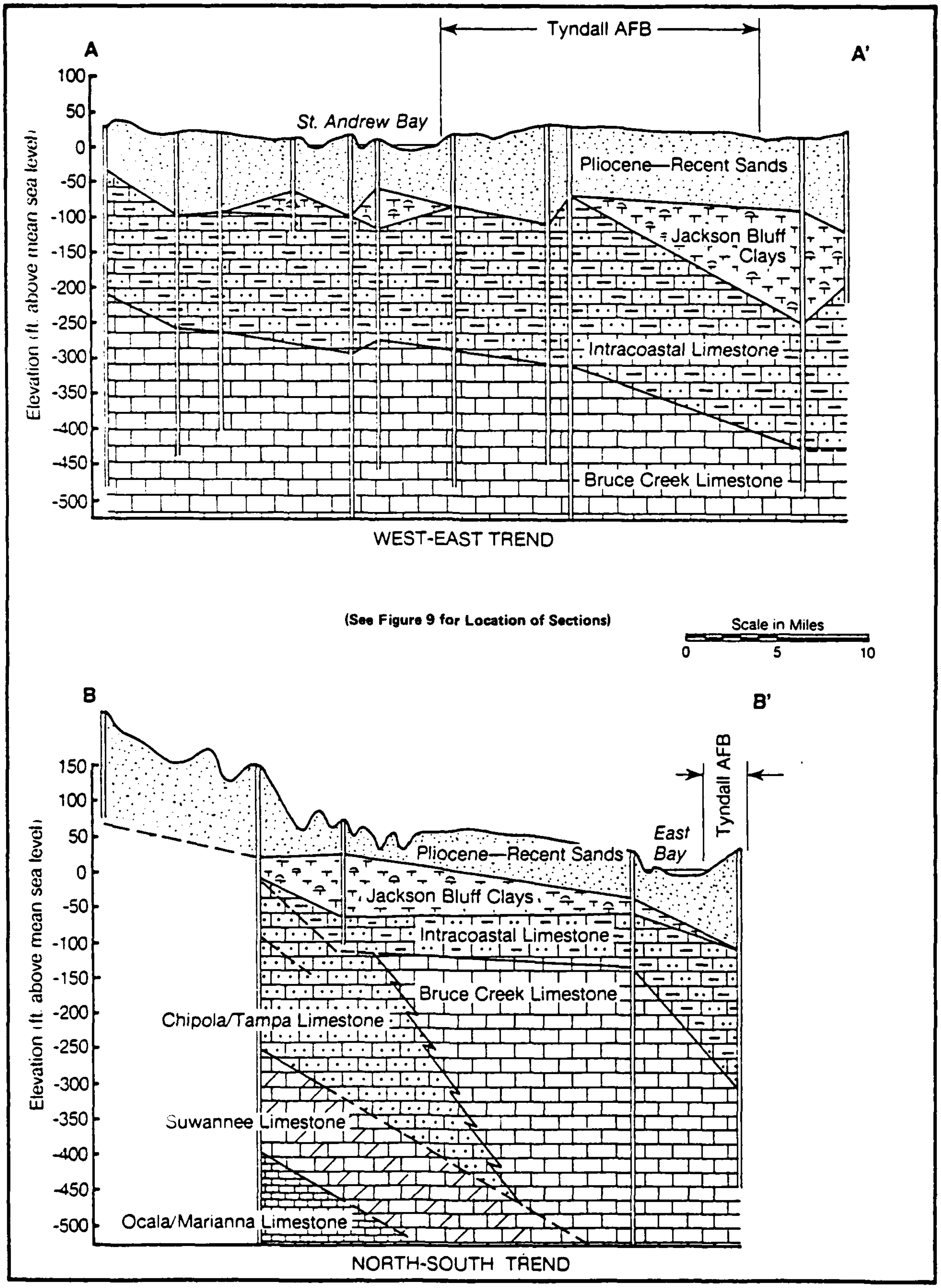
Typical soil and rock formations underlying the peninsula are illustrated on Figure 10. Sands and clayey sands of Pliocene to Recent Age (10 million years ago to present) extend to a depth of approximately 110 feet. These soils are moderately permeable, and transmit water readily. Occasional clayey sand and hardpan layers occur at varying depths within the formation and impede the downward movement of groundwater. In some parts of Bay County, the lower portion of this formation forms an impermeable clayey sand strata which effectively prevents groundwater movement. However, well logs available at Tyndall AFB did not record a significant thickness of clayey sand.

From 110 feet to approximately 330 feet deep, poorly cemented shell beds of the Intracoastal Formation are present. This layer contains abundant




SOURCE: Hatch et al., 1981.

**FIGURE 9. Physiographic Subdivision Map of Bay County**




SOURCE: Hatch et al., 1981.

**FIGURE 10. Typical Geologic Cross Sections, Bay County**

fossils, quartz sand, and calcium carbonate grains that are cemented by crystalline calcite and clay. The upper portion of the formation is of Pliocene Age (less than 10 million years ago) and is relatively impermeable, whereas the lower portion is of Miocene Age (more than 10 million years ago) and is highly permeable.

Below 330 feet deep and extending to depths greater than 600 feet are limestones of Miocene Age which belong to the Bruce Creek Formation. These limestones are white to light yellow-grey and moderately consolidated. Permeability is very high because of interconnected voids and solution cavities in the limestone.

Formations below 600 feet consist of various strata of limestone, clay, sandstone, shale, and quartzite down to a basement granite occurring at a depth of approximately 13,000 feet below land surface.

### 2.3 HYDROLOGY

Rainfall on the Tyndall AFB peninsula either percolates into the ground directly or flows across the ground surface into water bodies surrounding the peninsula. In general, runoff from areas on the north side of Highway 98 flow into East Bay and St. Andrew Bay and areas on the south and west sides of Highway 98 drain into St. Andrew Sound, St. Andrew Bay, and the Gulf of Mexico.

In the vicinity of the flight line, maintenance and administrative areas, and family housing areas, the predominant surface water drainage features consist of storm sewers and ditches. Surface drainage features and directions of drainage runoff are shown on Figure 11.

Rainfall that percolates into the ground is stored temporarily in the water table aquifer, which is the uppermost of two aquifer systems. This 100-foot-thick aquifer is composed of fine to coarse sand with typical moderate permeability values on the order of 0.01 centimeters per second. The water table aquifer has a water surface that rises during periods of heavy rainfall and declines during periods of low rainfall. Yearly

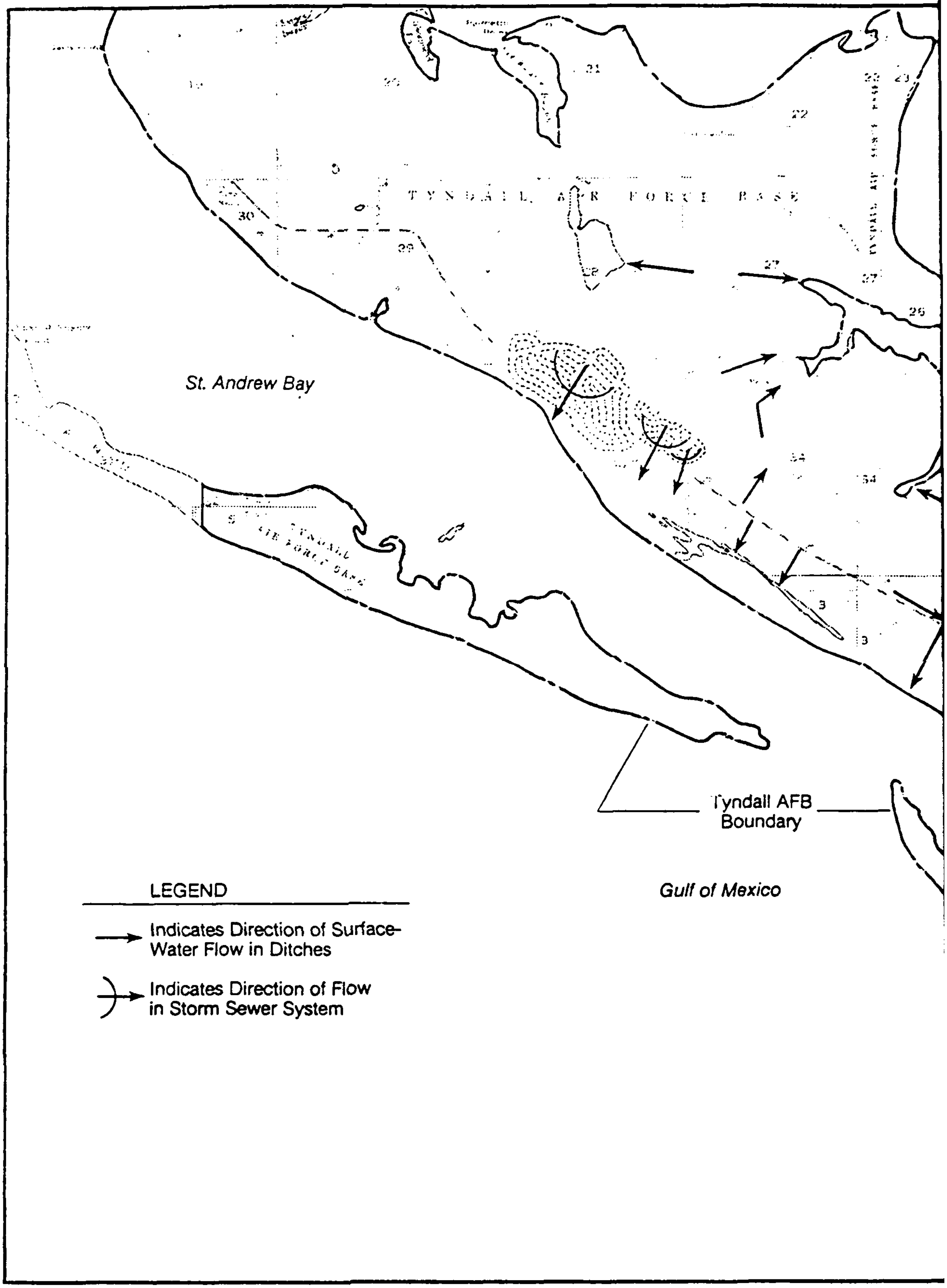
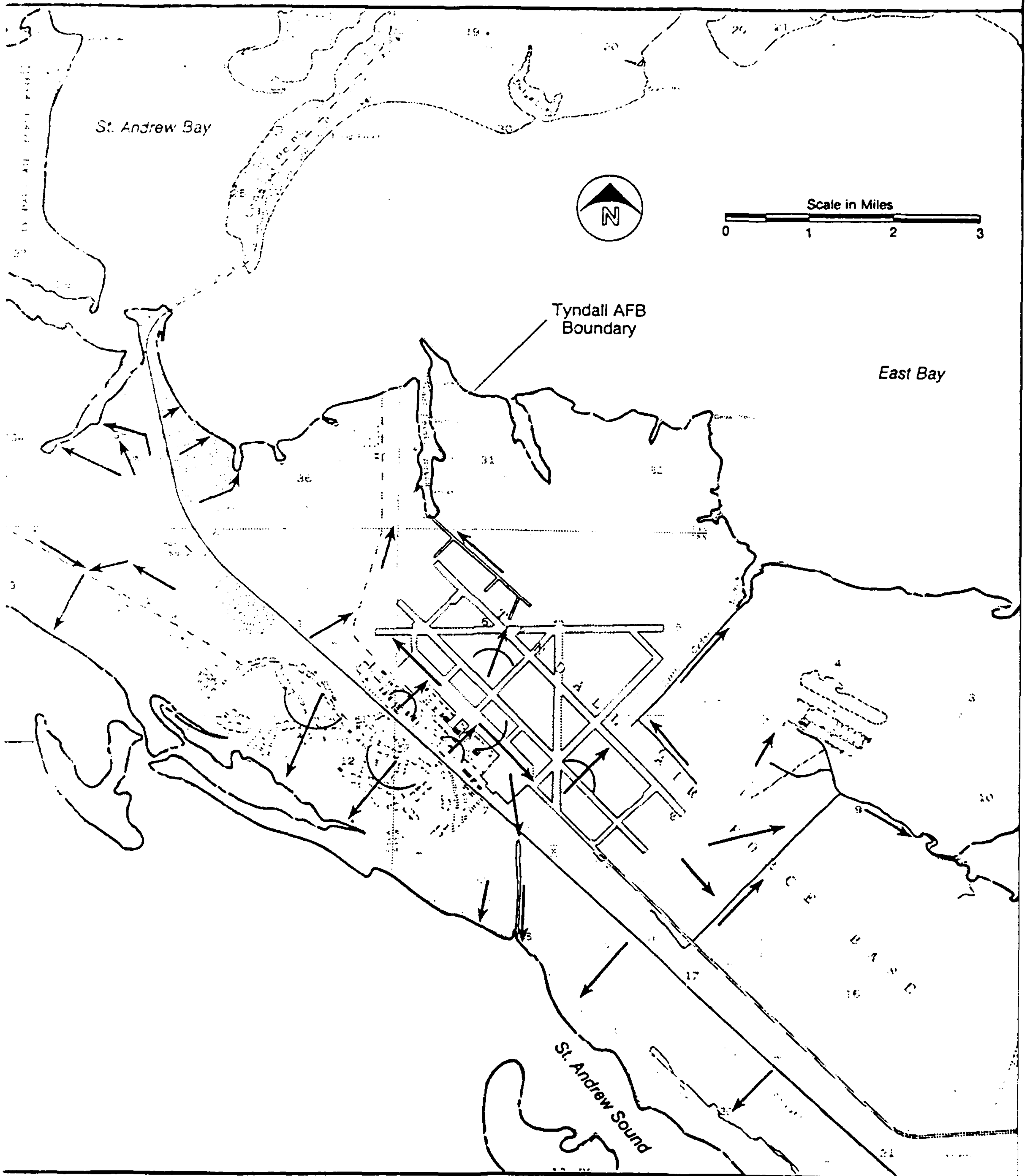
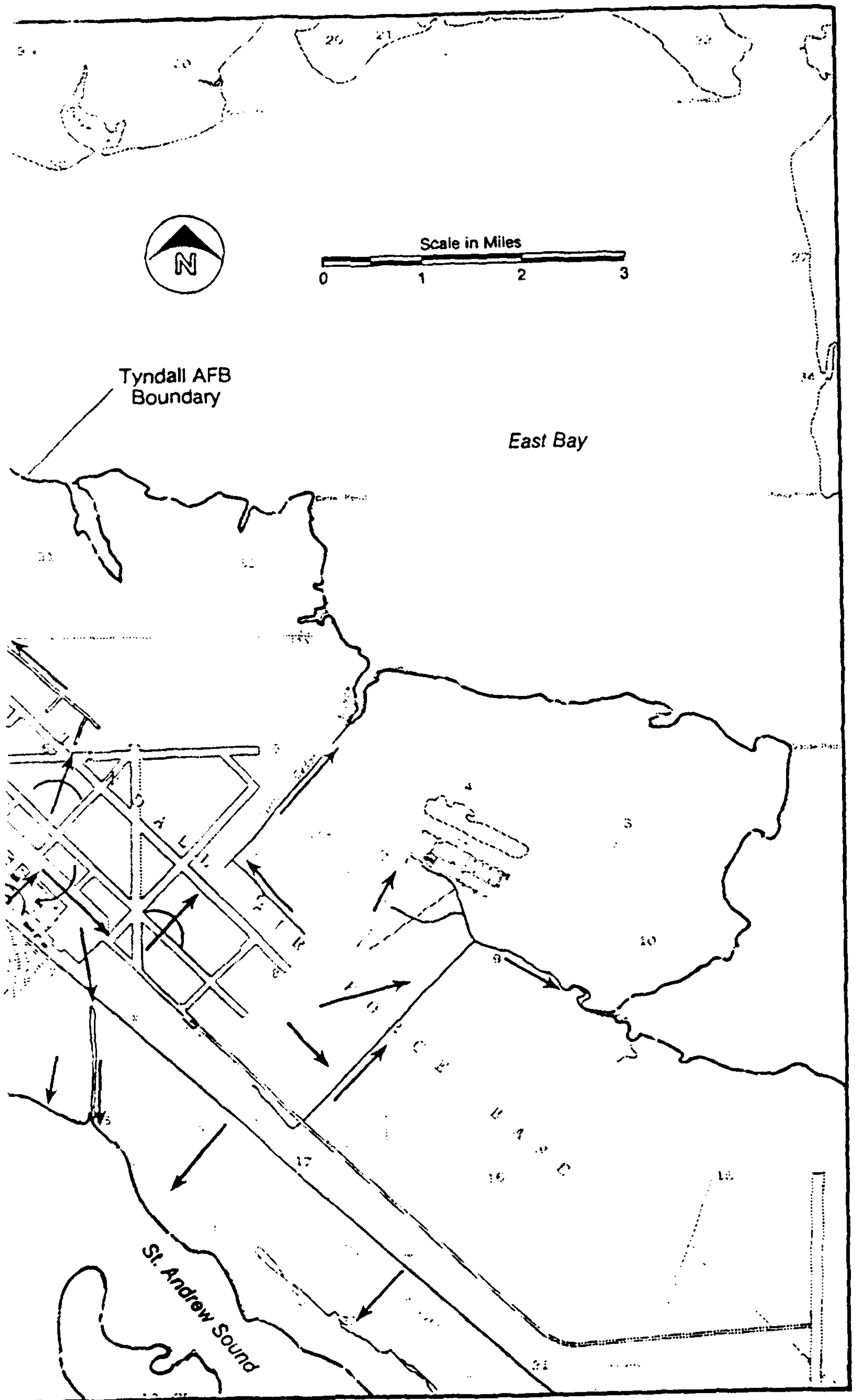



FIGURE 11. Surface Drainage Map


St. Andrew Bay
Scale in Miles
0
1
2
3
Tyndall AFB
Boundary
East Bay
St. Andrew Sound

SOURCE




SOURCE: Hatch et al., 1981.

fluctuations on the order of 5 feet are typical. The average depth to groundwater varies from about 1 to 10 feet over most of the base, but may be as deep as 15 feet near the coastal ridge along Highway 98.

The slope of the water table is relatively flat throughout the base. In general, the direction of groundwater movement follows the slope of the overlying terrain, flowing northeast and southwest from a high near the coastal ridge along Highway 98 (Figure 11). This regional pattern of groundwater movement is affected locally by bayous, streams, and ditches, where groundwater flows directly to these surface waters.

Perched groundwater is present in isolated areas throughout the base where clayey sand and hardpan layers trap rainfall above the level of the surrounding water table. Perched groundwater joins the regional groundwater aquifer where the confining layers are breached or absent.

Leachate from any landfill or disposal area on Tyndall AFB would probably travel downward to the water table aquifer, then follow the local pattern of groundwater movement towards streams, bayous or ditches; or directly to bays surrounding the peninsula. Even though soils in the Tyndall AFB area are moderately permeable, the rate of migration of any contaminated plume would be relatively slow due to the gradual slope of the water table. Where lenses of clayey sand and hardpan are present, vertical movement of leachate will be impeded. The contaminated plume will migrate very slowly along the perched water table until joining the groundwater aquifer wherever the hardpan is breached or absent.

The second aquifer system at Tyndall AFB, the Floridan Aquifer, is separated from the upper water table aquifer by the clayey sand and clayey shell stratum which is about 150 feet thick. Permeability of this clayey sand and clayey shell stratum is unknown, but is believed to be low because of its clay content. The Floridan Aquifer occupies the lower permeable portions of the Intracoastal Formation as well as the highly permeable limestones of the Bruce Creek Formation. The aquifer is

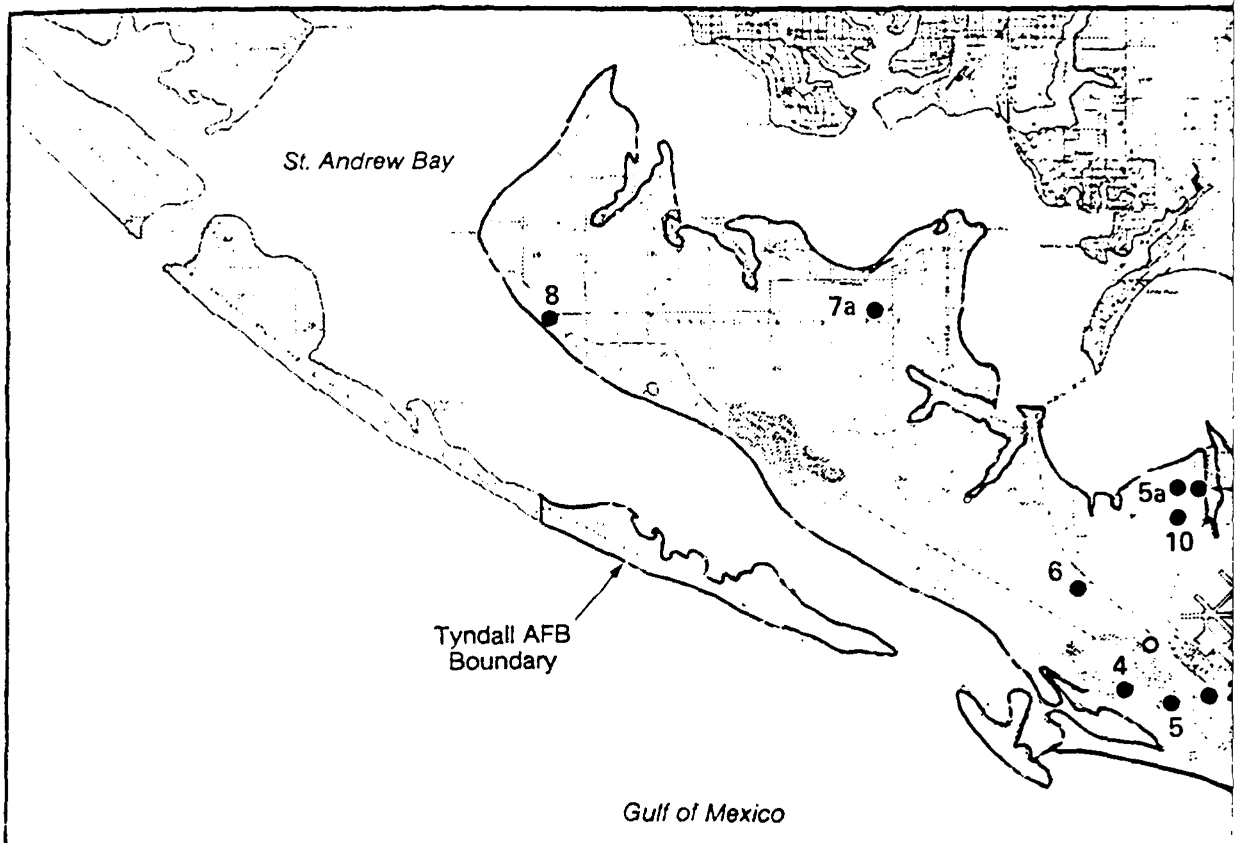
approximately 1,100 feet thick, although potable water occurs only between depths of about 250 and 500 feet. The average transmissivity of the Floridan Aquifer is estimated to be on the order of 100,000 gallons per day (gpd) per foot.

Seventeen wells at Tyndall AFB tap the Floridan Aquifer. The locations and depths of these wells are shown on Figure 12. The average yield of these wells is estimated to range from 5 to 10 gallons per minute (gpm) per foot of drawdown.

The Floridan Aquifer is an artesian aquifer; that is, water levels in wells completed in this aquifer rise above the top of the aquifer. Water levels in the vicinity of Tyndall AFB are indicated by the potentiometric surface contour map shown on Figure 13. Pumping from wells on the base causes localized depressions in the potentiometric surface, and may lower the surface below msl to an extent dependent on the rate of pumping. The main water supply for Tyndall AFB is obtained from Bay County. Less than 1 percent of the water demand is withdrawn from wells located on Tyndall AFB.

Most of the water in the Floridan Aquifer originates in Washington, Holmes, and Jackson Counties in Florida and in southern Alabama. Local recharge is effectively prevented by strata of low permeability in the upper portions of the Intracoastal Formation. Water within the Floridan Aquifer flows underground in a southwesterly direction beneath the Tyndall AFB peninsula and eventually exits into the Gulf of Mexico.

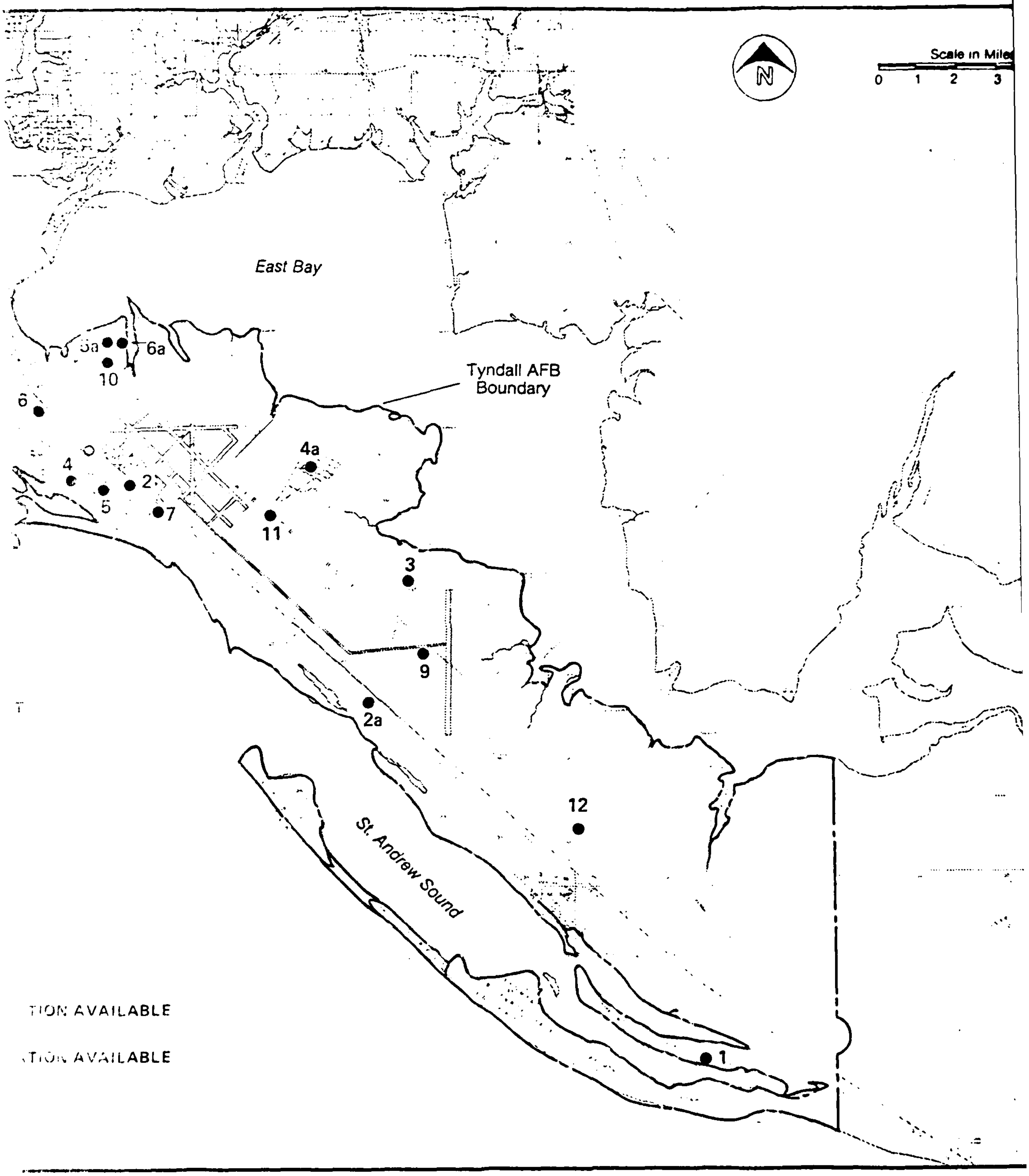
The potential for off-base migration of leachate vertically to the Floridan Aquifer is low due to the presence of low-permeability confining stratum about 150 feet thick. In the unlikely event that contamination percolates through to the Floridan Aquifer, it would be collected in Tyndall AFB wells or would migrate to the southwest and exit into the Gulf of Mexico. The closest public water supply wells are located near Hathaway Bridge, approximately 12 miles northwest of Tyndall AFB. These wells are not downgradient from Tyndall AFB disposal sites and could not be impacted by migration of contaminants from those sites.




LEGEND

| POTABLE WATER WELLS | DEPTH, FEET |
|---|---|
| 1. BLDG 9705/AFESC PAVEMENT EVALUATION | 570 |
| 2. BLDG 7221/CLOSED | 653 |
| 2a. BLDG 8523/DRONE LAUNCH | 130 |
| 3. BLDG 8510/CLOSED | 658 |
| 4. BLDG 1502/CLOSED | 435 |
| 4a. BLDG 7001/AMMO STORAGE | 435 |
| 5. BLDG 625/2021 COMM. | 487 |
| 5a. BLDG 6033/POL AREA | 463 |
| 6. BLDG2675/WHERRY HOUSINF NEAR ST. JOE PHONE CO. | 644 |
| 6a. BLDG 6055/POL AREA | 580 |
| 7. BLDG 250/FORMER COLD STORAGE | 645 |
| 7a. BLDG 3003/BOY SCOUT AREA | NO INFORMATION AVAILAE |
| 8. BLDG 3029/GOLF COURSE | 490 |
| 9. BLDG 9306/DRONE MAINTENANCE | NO INFORMATION AVAILAE |
| 10. BLDG 6065/POL AREA | 600 |
| 11. BLDG 1061/ALERT FACILITY | 115 |
| 12. PRIME BEEF AREA | 521 |

FIGURE 12. Location of Potable Water Wells

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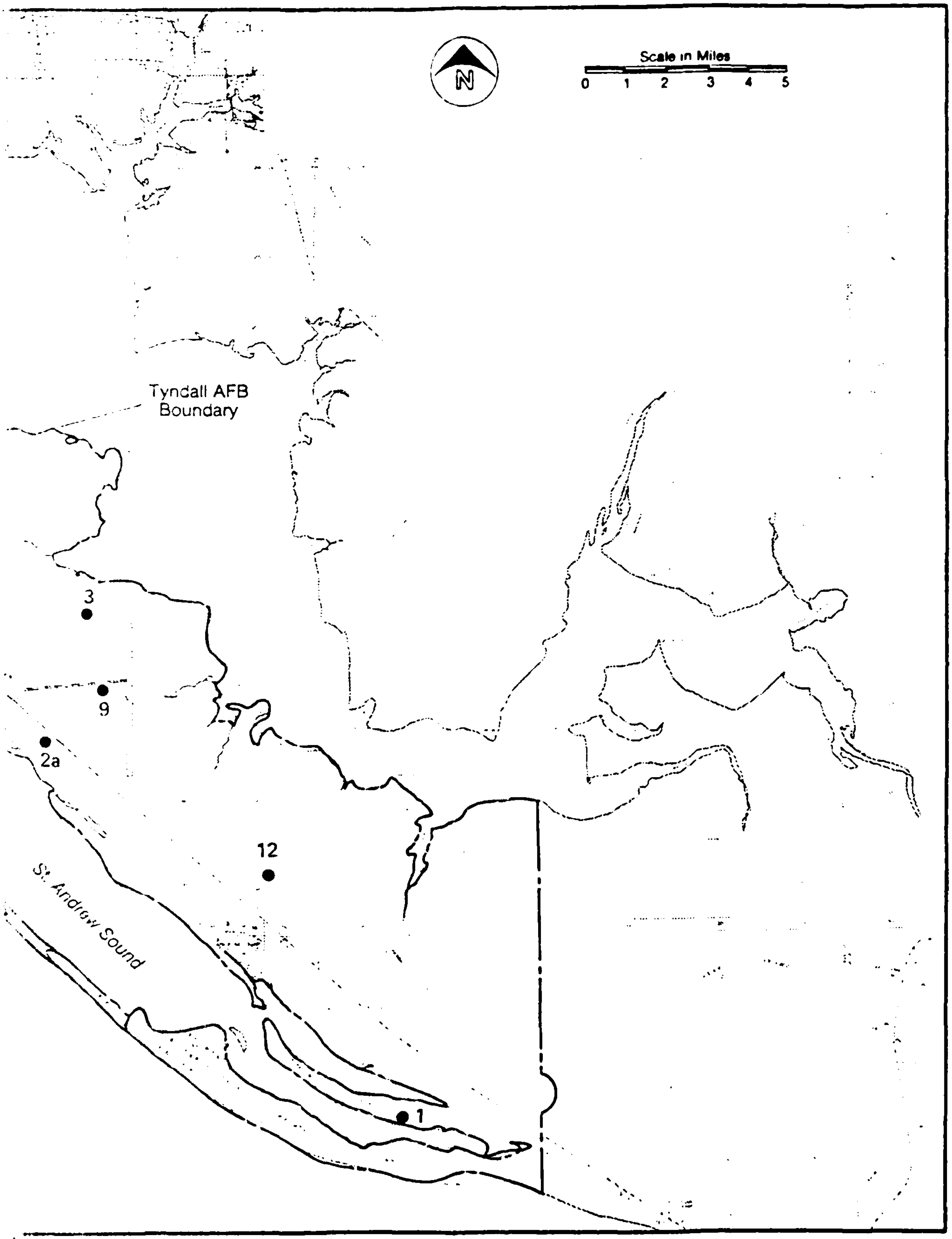
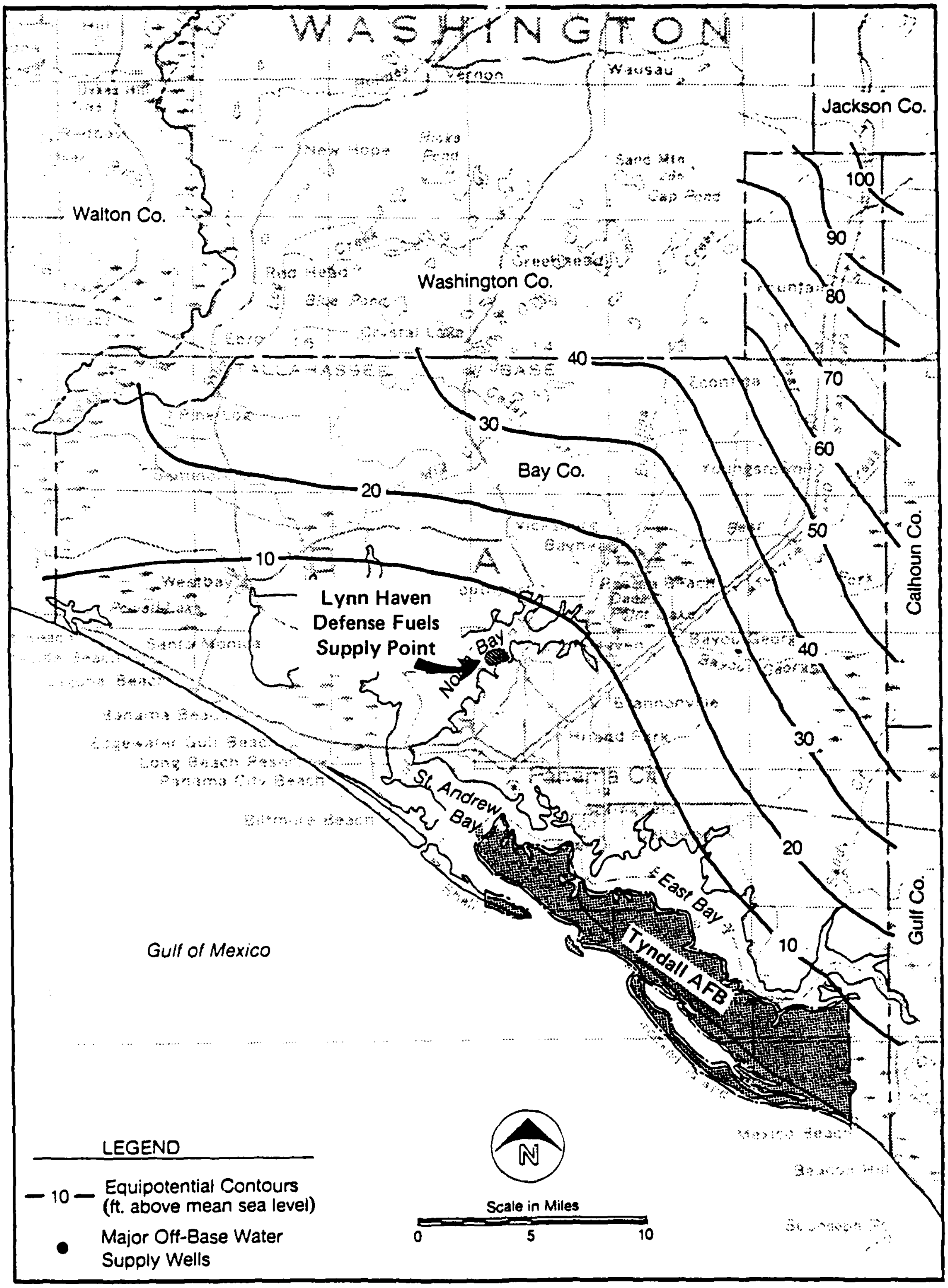



SOURCE: Hatch et al., 1981.




SOURCE: Hatch et al., 1981.

**FIGURE 13. Potentiometric Surface of the Floridan Aquifer, 1980.**

# 3.0 FIELD PROGRAM

# 3.0 FIELD PROGRAM

## 3.1 DEVELOPMENT OF FIELD PROGRAM

The Tyndall AFB Phase IIb field program was developed based on findings and recommendations of the Phase I records search (Hatch et al., 1981), Phase IIa presurvey (WAR, 1983), additional information obtained subsequent to these IRP surveys, and discussions with USAF Occupational and Environmental Health Laboratory (OEHL) personnel. A summary of the Phase IIb monitoring and analysis work plan is given in Table 2. The complete scope of work appears in Appendix B. Locations of monitoring wells and sampling points are shown in Figures 3 through 8. In many instances the work scope reflects modifications of Phase I and Phase IIa recommendations enacted due to changes in contamination assessment or screening strategies and/or budgetary constraints.

The Tyndall AFB Phase IIb survey was designed primarily as a screening survey to determine whether contamination of sites is sufficient to warrant mitigation or further monitoring. In addition to analyses for specific parameters, the survey utilizes general screening parameters such as pH, specific conductance, total phenolics, DOC, and TOX to detect the presence of nonspecific classes of pollutants. DOC is used in preference to total organic carbon (TOC) because it is a more representative indicator of liquid organic contamination capable of migrating with surface water or groundwater. An unfiltered TOC sample from a shallow well may contain significant quantities of naturally-occurring particulate organic matter. The parameters pH, specific conductance, DOC, and TOX are often collectively referred to as groundwater contamination indicators (GWCI). For sites where values of screening parameters are high enough to indicate that a problem may exist, additional sampling and analyses are recommended to determine the extent of contamination. Upgradient or background wells were omitted from the Phase IIb survey because of its design as a screening survey. If determination of natural background groundwater quality is necessary to assess contamination at a given site, upgradient wells will be installed at a later date.

Table 2. Tyndall AFB Phase IIb Monitoring and Analysis Work Plan (Page 1 of 5)

| Site Description | Monitoring/Analysis Descriptions* | Rationale |
|---|---|---|
| Main Base Landfills (Zone 1, Sites 6 and 7) | Install six wells downgradient from the zone | Sample shallow groundwater migrating from landfill to adjacent surface water. |
| | Sample one existing sewage sprayfield monitoring well | Check possible effects of sprayfield on shallow groundwater quality. |
| | Collect four surface water samples and three sediment samples from drainage ditch separation landfills | Ditch is obvious pathway for contaminants to migrate from landfills. |
| | Collect one water sample from each location and analyze for: | |
| | pH, Sp. Cond., DOC**, TOX | Indicators of nonspecific groundwater contamination. |
| | Total phenolics | Indicator of presence of phenolic paint strippers. |
| | Cadmium, chromium, lead, nickel† | Possible contaminants from waste batteries and waste cleaning solutions. |
| | Iron, zinc | Metals prevalent in landfill leachate; toxic to estuarine/marine biota in sufficient quantities. |
| | Analyze sediment samples for: | |
| | TOX | Screen for accumulation of halogenated organics in sediments. |
| Main Base Landfills | Cadmium, chromium, lead, nickel, iron and zinc | Same rationale as listed above for water; if present in water, metals will accumulate in sediments. |
| | DDT and metabolites | Common pesticide used on base in the past. |

Table 2. Tyndall AFB Phase IIb Monitoring and Analysis Work Plan (Page 2 of 5)

| Site Description | Monitoring/Analysis Descriptions* | Rationale |
|---|---|---|
| Lynn Haven DFSP (Zone 2, Site 18) | Install seven temporary monitoring wells within zone | Allows for monitoring Bunker C disposal site (two wells), migration to North Bay (three shoreline wells), migration to east (one well), and monitoring groundwater in railcar loading area (one well). |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of fuels and other nonspecific groundwater contamination. |
| | Lead | Indicator of leaded fuel sludge contamination. |
| | Oil and grease | Indicator of fuel contamination. |
| | Approximate depth of fuel layer if present | Indicator of fuel contamination. |
| POL Area A (Zone 3, Site 14) | Install four temporary monitoring wells around site | Provide sufficient downgradient coverage to detect contaminant migration. |
| POL Area A (Zone 3, Site 14) | Sample existing potable water well within zone | Determine if contaminants have reached well. |
| | Collect one water sample from each monitoring well and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of nonspecific groundwater contamination. |
| | Lead | Indicator of leaded fuel sludge contamination. |
| | Oil and grease | Indicator of fuel contamination. |
| | Analyze potable well sample for VOA, VOH | Indication of purgeable organic contamination from fuels in potable well. |

Table 2. Tyndall AFB Phase IIb Monitoring and Analysis Work Plan (Page 3 of 5)

| Site Description | Monitoring/Analysis Descriptions* | Rationale |
|---|---|---|
| AAFES Service Station (Zone 4, Site A) | Install one well near former leaking gasoline tank. Measure approximate depth of fuel layer if present | Indication of gross fuel contamination in shallow groundwater. |
| Small Arms Repair Area (Zone 5, Site B) | Install three wells within zone | Provide sufficient coverage to detect contaminant migration. |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of nonspecific groundwater contamination. |
| | Chromium, lead | Indicators of contamination from waste paints. |
| Highway 98 Fire Training Area (Zone 6, Site 17) | Install three wells within zone | Provide sufficient coverage to detect contaminant migration. |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC | Indicators of nonspecific groundwater contamination. |
| | Total phenolics | Indicator of contamination from phenolic paint strippers. |
| | Lead | Indicator of contamination from leaded fuels. |
| | VOA, VOH | Indicators of contamination from chlorinated solvents. |
| Southeast Runway Extension Burial Site (Zone 7, Site 4) | Install three wells within zone | Provide sufficient coverage to detect contamination migration. |
| | Sample existing potable water well at alert facility east of site | Determine if contaminants have reached well. |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC | Indicators of nonspecific groundwater contamination. |

Table 2. Tyndall AFB Phase IIb Monitoring and Analysis Work Plan (Page 4 of 5)

| Site Description | Monitoring/Analysis Descriptions* | Rationale |
|---|---|---|
| | Total phenolics | Indicator of contamination from phenolic paint strippers. |
| | Lead | Possible contaminant from waste batteries. |
| Southeast Runway Extension Burial Site (Zone 7, Site 4) | VOA, VOH | Indicators of contamination from waste solvents. |
| 6000 Area Landfill (Zone 8, Site 5) | Install two wells within zone | Detect contaminant migration from zone. |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of nonspecific groundwater contamination. |
| | Total phenolics | Indicator of contamination from paint strippers. |
| | Chromium, lead, zinc | Indicators of contamination from waste paints, batteries. |
| POL Area B (Zone 9, Site 15) | Install two wells within zone | Monitor shallow groundwater for fuel contamination. |
| | Collect one water sample from each well and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of fuels and other nonspecific groundwater contamination. |
| | Lead | Indicator of contamination from leaded fuel sludge. |
| Shell Bank Fire Training Area (Zone 10, Site 16) | Install four backhoe pits within zone | Obtain single sampling of groundwater without obstructing vehicular traffic in area. |

Table 2. Tyndall AFB Phase IIb Monitoring and Analysis Work Plan (Page 5 of 5)

| Site Description | Monitoring/Analysis Descriptions* | Rationale |
|---|---|---|
| | Collect one water sample from each pit and analyze for: | |
| | pH, Sp. Cond., DOC, TOX | Indicators of POL and other nonspecific groundwater contamination. |
| | Total phenolics | Indicator of contamination from phenolic paint strippers. |
| | Lead | Indicator of contamination from leaded fuels. |

*See Appendix A for explanation of analytical abbreviations.

**DOC = Dissolved total organic carbon. Samples were filtered through a 0.45-micron filter before preservation with $H_2SO_4$. This ensures that the test results are representative of dissolved forms of organic carbon which would migrate in groundwater.

†All metals were filtered through a 0.45-micron filter before preservation with $HNO_3$. This ensures that results for metals are representative of dissolved forms which would migrate with groundwater.

Note: All sampling locations described above were sampled once to provide a general screening for the indicated specific or nonspecific parameters. Where the presence of contamination is indicated, subsequent sampling will be recommended to more accurately define the extent of contamination.

The Tyndall AFB Phase I records search recommended Phase IIb programs for site Nos. 6, 7, 14, and 18 based on the Air Force Site Rating Methodology (Hatch et al., 1981). After completion of the Phase I records search, HARM was developed and applied to Tyndall AFB Phase I sites. Application of HARM, an updated and improved version of the previous rating methodology, resulted in recommending five additional Phase I sites for Phase IIb confirmation; site Nos. 4, 5, 15, 16, and 17.

After completion of Phase I work, two additional sites were discovered. Site A, the AAFES Service Station; and Site B, the Small Arms Repair Area. A gasoline storage tank was reported to be leaking at Site A and infiltrating to nearby storm sewers. The leaking tank has since been removed. Conversations with base personnel revealed that Site B may have received significant quantities of waste paints and solvents.

## 3.2 IMPLEMENTATION OF FIELD PROGRAM

The Phase IIb field program consisted of monitoring well installation and collection of groundwater, surface water, and sediment samples for laboratory analyses. These activities are described in the sections below. The safety plan in Appendix H was adhered to throughout the field program.

### 3.2.1 Monitoring Well Installation

Monitoring wells were installed November 4-11, 1983 by Wright Test Drilling, Inc., located in Mobile, Alabama. Wells were installed through 6-inch outer diameter hollow-stem augers. Split-spoon samples were collected after every 5 feet of drilling according to American Society for Testing Materials (ASTM) D-1586-67. If necessary, auger fill was removed from the auger stem with a "sand bucket" bailer prior to collecting split spoon samples. Soil samples were given visual classifications and descriptions in the field for preparation of a lithologic log for each well. Completion logs for all wells installed during the Phase IIb survey appear in Appendix C.

Monitor well casings and screen sections consist of 2-inch schedule 40 polyvinyl chloride (PVC) with threaded, flush joints. Slot width of the screen sections is 0.010 inch. Casing and screen sections were cleaned with potable water prior to installation. After augering to the desired depth, the preassembled PVC well section was installed through the auger stem. If necessary, the auger stem was bailed with a sand bucket to remove auger fill. Augers were then withdrawn, allowing sand below the water table to collapse around the screen and form a native sand filter pack. Height of the casing top was adjusted to approximately 2.5 feet above the ground surface.

Permanent wells were backfilled with sand auger cuttings to approximately 4.5 feet below the ground surface. A bentonite seal approximately 1 foot thick was placed on top of the sand. The remainder of the annular space was filled with sand-cement grout. A 5-foot by 6-inch steel protective casing with hinged, locking lid was installed into the grout until the top was within 2 to 6 inches of the PVC casing top. Above-ground portions of the steel casings were painted. Both steel and PVC casings are vented. Each well is equipped with a 4-foot by 1.25-inch PVC bailer attached by nylon cord to the screw-on PVC casing cap.

Temporary wells were backfilled with sand auger cuttings to approximately 1 foot below the ground surface. The remainder of the annular space was filled with bentonite. Protective casings were not installed on temporary wells. These wells were not grouted and can be easily removed when it is no longer desired to sample them.

Diagrams of well installations are shown on the well completion logs in Appendix C. A summary of monitoring well dimensions is given in Table 3.

Each well was developed by bailing a minimum of five times the volume of water standing in the casing. All tools used within the hole were washed

Table 3. Monitoring Well Dimensions

| Zone No. | Well Location No. | Approximate Distance From Site (feet) | Well Casing/ Screen Diameter (in.) | Total Well Depth (ft.) | Depth Interval of Screen Section (ft.-ft.) | Depth to Groundwater at Time of Sampling (ft.) |
|---|---|---|---|---|---|---|
| 1 | T1-1 | 0* | 2 | 15.2 | 5.5-14.5 | 4.2 |
| | T1-2 | 0* | 2 | 15.2 | 5.5-14.5 | 5.5 |
| | T1-3 | 50 | 2 | 15.3 | 5.6-14.6 | 3.1 |
| | T1-4 | 20 | 2 | 16.1 | 6.4-15.4 | 10.5 |
| | T1-5 | 50 | 2 | 15.2 | 5.5-14.5 | 4.5 |
| | T1-6 | 0* | 2 | 15.3 | 5.6-14.6 | 1.9 |
| 2 | LH2-1 | 20 | 2 | 13.3 | 0.8-12.8 | 3.5 |
| | LH2-2 | 50 | 2 | 13.3 | 0.8-12.8 | 2.7 |
| | LH2-3 | 50 | 2 | 13.3 | 0.8-12.8 | 2.9 |
| | LH2-4 | 70 | 2 | 13.3 | 0.8-12.8 | 3.1 |
| | LH2-5 | 60 | 2 | 13.3 | 0.8-12.8 | 3.1 |
| | LH2-6 | 60 | 2 | 13.3 | 0.8-12.8 | 3.9 |
| | LH2-7 | 50 | 2 | 12.0 | 0.8-12.0 | 3.6 |
| 3 | T3-1 | 30 | 2 | 10.3 | 1.0-9.8 | 3.5 |
| | T3-2 | 80 | 2 | 10.3 | 1.0-9.8 | 3.0 |
| | T3-3 | 330 | 2 | 9.3 | 1.0-8.5 | 1.0 |
| | T3-4 | 480 | 2 | 10.3 | 2.0-9.5 | 4.3 |
| 4 | T4-1 | 80 | 2 | 20.1 | 5.5-19.4 | 6.0 |
| 5 | T5-1 | 50 | 2 | 15.3 | 5.5-14.5 | 4.4 |
| | T5-2 | 50 | 2 | 15.3 | 5.5-14.5 | 4.8 |
| | T5-3 | 50 | 2 | 15.3 | 5.5-14.5 | 3.6 |
| 6 | T6-1 | 10 | 2 | 19.1 | 4.3-18.3 | 2.4 |
| | T6-2 | 50 | 2 | 20.5 | 5.7-19.7 | 0.7 |
| | T6-3 | 10 | 2 | 20.3 | 5.5-19.5 | 2.6 |
| 7 | T7-1 | 100 | 2 | 15.3 | 5.5-14.5 | 1.2 |
| | T7-2 | 200 | 2 | 15.3 | 5.5-14.5 | 0.9 |
| | T7-3 | 200 | 2 | 15.6 | 5.8-14.8 | 0.6 |
| 8 | T8-1 | 50 | 2 | 15.3 | 5.5-14.5 | 2.2 |
| | T8-2 | 20 | 2 | 15.3 | 5.5-14.5 | 1.5 |
| 9 | T9-1 | 150 | 2 | 20.2 | 5.4-19.4 | 4.1 |
| | T9-2 | 40 | 2 | 20.6 | 5.8-19.8 | 3.8 |

*Well placed at edge of site.

Note: See Appendix C for well completion logs.

with potable water between wells to minimize the possibility of cross-contamination.

A survey of all monitoring wells installed under the Phase IIb contract was performed between January 25 and February 15, 1984. Horizontal coordinates were determined to within ±3.0 feet and casing top elevations to within ±0.1 foot msl. Well coordinates and elevations are entered on well completion logs (Appendix C).

### 3.2.2 Backhoe Pits

Four pits were excavated in Zone 10 with a backhoe in order to examine soils for evidence of fuel contamination and obtain samples of shallow groundwater.

### 3.2.3 Sample Collection

Water and sediment samples were collected from all 10 Tyndall AFB disposal zones between November 29 and December 3, 1983. A listing of samples collected from each zone is given in Table 2. General sampling procedures for each sample type are described below. Sample collection procedures for specific analytes are described in Appendix E. Sample container descriptions, preservation methods, and holding times are listed in Table E-1 of Appendix E. Sample chain of custody forms are reproduced in Appendix F.

3.2.3.1 **Well Samples**--Prior to collecting well samples, depth to the water surface was measured and the volume of standing water in the well was determined. A minimum of five times the volume of standing water was removed from the well by pumping or bailing.

Specific conductance, temperature, and pH measurements were taken from a plastic bucket filled with the bailer immediately prior to sample collection. Sample bottles were filled from the bailer with strict adherence to quality assurance procedures described in Appendix E.

Bottle numbers and field observations were recorded on field data sheets, reproduced in Appendix D.

3.2.3.2 Surface Water Samples--Before collecting surface water samples, the total water depth was estimated and specific conductance, temperature, and pH were measured *in situ*. Each sample location was marked by driving a stake into the adjacent bank. Grab samples were collected in the appropriate bottles at approximately mid-channel. Bottle numbers and field observations were recorded on field data sheets.

3.2.3.3 Sediment Samples--Sediment samples were collected at three of the four surface water sampling locations. A ponar-type dredge was used to collect the samples where bottom conditions permitted. Where excessive vegetation or rocks prohibited use of the ponar, samples were collected with a small trowel or shovel. Sample bottle numbers and field observations were recorded on field data sheets.

3.2.3.4 Backhoe Pits--Immediately following excavation of the pits, depth to the water surface was estimated and a backhoe bucket of water was retrieved. Grab samples were collected in appropriate bottles directly from the backhoe bucket. Specific conductance, temperature, and pH were measured in the bucket prior to sample collection. Exposed soil in the backhoe pits was examined for evidence of fuel contamination. Sample bottle numbers and field observations were recorded on field data sheets.

# 4.0 DISCUSSION OF RESULTS AND SIGNIFICANT FINDINGS

## 4.0 DISCUSSION OF RESULTS AND SIGNIFICANT FINDINGS

### 4.1 RELEVANT WATER QUALITY CRITERIA AND STANDARDS

#### 4.1.1 Florida Drinking Water Standards

All groundwaters sampled during the Tyndall AFB Phase IIb survey are classified G-II according to the Florida Department of Environmental Regulation (FDER) (Lent, 1984). Section 17-3.404 of the Florida Administrative Code (FAC) (FDER, 1983) states that all Class G-I and G-II groundwaters must meet Florida primary and secondary drinking water standards established by the Florida Safe Drinking Water Act (FDER, 1982), unless natural background concentrations exceed the standards or the water in question is within a permitted zone of discharge. Table 4 lists MCLs established by Florida drinking water regulations for parameters analyzed in the Phase IIb survey. MCLs are not established for all survey parameters.

Based on inspection of Tyndall AFB Phase IIb data (Tables 8 through 11) natural background levels for the six parameters listed in Table 4 are within MCLs, with the possible exception of pH. As noted in Section 3.1, upgradient (background) wells were not installed at Tyndall AFB disposal sites. Of 37 groundwater pH readings taken at Tyndall AFB during the Phase IIb survey, 25 are below the minimum MCL of 6.5. These data suggest that the natural background for pH at Tyndall sites is probably below the MCL of 6.5. Paragraph 17-3.404(2) of the FAC states that if the natural background pH is lower than the minimum, the background value shall be the prevailing standard.

Paragraph 17-3.404 of the FAC states that drinking water standards do not apply to groundwaters within a permitted zone of discharge. There are no such permited zones at Tyndall AFB or Lynn Haven DFSP, thus this exemption from the standards does not apply.

#### 4.1.2 EPA Interim Drinking Water Regulations

Standards established by these regulations are not directly applicable to groundwater sampled during the Tyndall AFB Phase IIb survey, as the

Table 4. Relevant Maximum Contaminant Levels for Drinking Water*

| Parameter | EPA Interim Drinking Water Standards† | Florida Drinking Water Regulations** |
|---|---|---|
| | Primary Standards (ug/l) | |
| Cadmium | 10 | 10 |
| Chromium | 50 | 50 |
| Lead | 50 | 50 |
| Total THMs†† | 100 | 100 |
| | Secondary Standards (ug/l except for pH) | |
| Iron | 300 | 300 |
| pH | 6.5 - 8.5 | 6.5 (minimum allowable; no maximum) |
| Zinc | 5,000 | 5,000 |

*MCLs are given only for parameters for which analytical results are reported in the Tyndall AFB Phase IIb survey.
**Source: Florida Drinking Water Regulations, Section 17-22.104 F.A.C.
†Source: EPA National Interim Drinking Water Regulations, 40 CFR 143.
††Sum of bromodicnloromethane, dibromochloromethane, tribromomethane (bromoform), and trichloromethane (chloroform).

regulations pertain to public water systems. However, MCLs established by EPA interim primary and secondary drinking water regulations are essentially those adopted by FDER. For parameters analyzed during this survey, the only difference between EPA and Florida MCLs is the absence of an upper limit on pH for the Florida MCLs. Since none of the pH values recorded during the Tyndall AFB Phase IIb survey exceed the EPA MCL maximum of 8.5 units, the EPA and Florida MCLs are identical for the purposes of this report. In all subsequent discussions, the term MCL will refer to the contaminant levels listed in Table 4, which are applicable under Florida regulations to all groundwaters sampled.

#### 4.1.3 Florida Criteria for Surface Waters

Florida Water Quality Standards (FWQS), FAC Section 17-3 (FDER, 1983) give criteria for three classes of water relevant to the Tyndall AFB Phase IIb survey. These are:

1. General (all surface waters except within zones of mixing);
2. Class II (surface waters for shellfish harvesting or propagation); and
3. Class III (surface waters for recreation, propagation, and management of fish and wildlife).

Table 5 gives Florida classifications for surface waters nearest each disposal site and approximate distances between surface waters and sites. Table 6 is a summary of Florida surface water criteria for parameters analyzed during the Tyndall AFB Phase IIb survey. Criteria are not established by FWQS for all parameters in the survey.

Surface water sampling for the Tyndall AFB Phase IIb survey was limited to the drainage ditch dividing the main base landfills in Zone 1. Only general criteria apply to this water. Surface water criteria for water bodies nearest the disposal sites are cited only for the basis of comparing groundwater quality (and drainage ditch water quality in the case of Zone 1) to the receiving surface water.

Table 5. Florida Classification of Surface Waters Nearest to Tyndall AFB Disposal Sites

| Zone No. | Phase I Site Nos. | Site Description | Name of Nearest Surface Water | Florida Surface Water Classification | Approximate Distance from Site (feet) |
|---|---|---|---|---|---|
| 1 | 6,7 | Main Base Landfills | Gulf of Mexico | III | <500 |
| 2 | 18 | Lynn Haven DFSP | North Bay | II | <500 |
| 3 | 14 | POL Area A | Shoal Point Bayou | II | <500 |
| 4 | A* | AAFES Service Station | Gulf of Mexico | III | 2,500 |
| 5 | B* | Small Arms Repair Area | East Bay | II | 1,000 |
| 6 | 17 | Highway 98 Fire Training Area | Gulf of Mexico | III | 3,000 |
| 7 | 4 | Southeast Runway Extension Burial Site | East Bay | II | 5,000 |
| 8 | 15 | 6,000 Area Landfill | East Bay | II | 1,500 |
| 9 | 5 | POL Area B | East Bay | III | 5,500 |
| 10 | 16 | Shell Bank Fire Training Area | Shoal Point Bayou | II | <500 |

*Site discovered subsequent to Phase I records search; site designations were assigned in Phase IIa presurvey.

Source: Hatch _et al._, 1981.

Table 6. Relevant Florida Surface Water Quality Criteria* (Page 1 of 3)

| Parameter | General Surface Water Criteria | Class II Surface Water Criteria | Class III Surface Water Criteria |
|---|---|---|---|
| Chromium | Shall not exceed 0.50 mg/l hexavalent or 1.0 mg/l total chromium in effluent discharge and shall not exceed 0.05 mg/l total chromium after reasonable mixing in the receiving water. | | |
| Lead | Shall not exceed 0.05 mg/l. | | Shall not exceed 0.03 mg/l in predominantly fresh waters. |
| Oil & Grease | 1. Dissolved or emulsified oils and greases shall not exceed 5.0 mg/l.<br>2. No undissolved oil, or visible oil defined as iridescence, shall be present to cause taste or odor, or otherwise interfere with the beneficial uses of waters. | | |
| pH | Shall not vary more than one unit above or below natural background provided that the pH is not lowered to less than 6 units or raised above 8.5 units. If natural background is less than 6 units, the pH shall not vary below natural background or vary more than one unit above natural background. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below background. | Shall not vary more than one unit above or below natural background of coastal waters as defined in 17-3.05(1)(c), FAC, or more than two-tenths unit above or below natural background of open waters as defined in 17-3.05(a)(c), FAC, provided that the pH is not lowered to less than 6.5 units or raised above 8.5 units. If natural background is less than 6.5 units, the pH shall not vary below natural background or vary more than one unit above natural background for coastal waters or more than two-tenths unit above natural background for open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of coastal waters or more than two-tenths unit below natural background of open waters. | Shall not vary more than one unit above or below natural background of predominantly fresh waters and coastal waters as defined in 17-3.05(1)(c), FAC, or more than two-tenths unit above or below natural background of open waters as defined in 17-3.05(1)(c), FAC, provided that the pH is not lowered to less than 6 units in predominantly fresh waters, or less than 6.5 units in predominantly marine waters, or raised above 8.5 units. If natural background is less than 6 units, in predominantly fresh waters or 6.5 units in predominantly marine waters, the pH shall not vary below natural background or vary more than one unit above natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit above natural background of open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit below natural background of open waters. |

Table 6. Relevant Florida Surface Water Quality Criteria* (Page 2 of 3)

| Parameter | General Surface Water Criteria | Class II Surface Water Criteria | Class III Surface Water Criteria |
|---|---|---|---|
| Phenolic Compounds | Chlorinated phenols including trichlorophenols; chlorinated creosols; 2-chlorophenol; 2,4-dichlorophenol and pentachlorophenol; 2,4-dinitrophenol; phenol-shall not exceed 1.0 ug/l unless higher values are shown not to be chronically toxic. Such higher values shall be approved in writing by the Secretary. Phenolic compounds other than those produced by the natural decay of plant material, named or unnamed, shall not taint the flesh of edible fish or shellfish or produce objectionable taste or odor in a drinking water supply. | | |
| Specific Conductance | Shall not be increased more than 100% above background levels or to a maximum level of 500 umhos/cm in surface waters in which the specific conductance of the water at the surface is less than 500 umhos/cm; and shall not be increased more than 50% above background level or to a maximum level of 5,000 umhos/cm in surface waters in which the specific conductance of the water at the surface is equal to or greater than 500 umhos/cm per centimeter but less than 5,000 umhos/cm. | | |
| Cadmium | | Shall not exceed 3.0 ug/l. | Shall not exceed 5.0 ug/l in predominantly marine waters, shall not exceed 0.8 ug/l in predominantly fresh waters in water with a hardness (in mg/l of $C_aCO_3$) of less than 150, and shall not exceed 1.2 ug/l in harder waters. |

Table 6. Relevant Florida Surface Water Quality Criteria* (Page 3 of 3)

| Parameter | General Surface Water Criteria | Class II Surface Water Criteria | Class III Surface Water Criteria |
|---|---|---|---|
| Iron | | Shall not exceed 0.3 mg/l. | Shall not exceed 1.0 mg/l in predominantly fresh waters; 0.3 mg/l in predominantly marine waters. |
| Nickel | | Shall not exceed 0.1 mg/l. | Shall not exceed 0.1 mg/l. |
| DDT | | Shall not exceed 0.001 ug/l. | Shall not exceed 0.001 ug/l. |
| Zinc | | | Shall not exceed .03 mg/l in predominantly fresh waters. |

*Criteria are given only for parameters for which analytical results are reported in the Phase IIb survey.

### 4.1.4 EPA Water Quality Criteria

EPA water quality criteria are intended as guidelines and have no regulatory impact. Ambient criteria provide guidelines for potable water and consumption of aquatic organics. Surface water (saltwater aquatic life) criteria can be used as a comparison to groundwater quality.

EPA has established water quality criteria for 64 toxic pollutants or pollutant categories (EPA, 1980). Criteria are given for freshwater and saltwater aquatic life and human health. A summary of criteria for parameters analyzed in the Tyndall AFB Phase IIb survey is given in Table 7. Criteria for freshwater aquatic life are not listed in Table 7 since there are no significant fresh water systems potentially impacted by disposal sites at Tyndall AFB.

Human health criteria are derived from animal toxicity data and are given as ambient criteria for noncarcinogenic pollutants, and concentrations estimated to cause a specified level of incremental cancer risk for carcinogens. Human health criteria assume that intake of the pollutant comes from two sources: (1) drinking an average of 2 liters of water per day, and (2) ingesting an average of 6.5 grams of fish per day. Concentrations shown for incremental cancer risk in Table 7 indicate those which are estimated to cause a lifetime carcinogenic risk of $10^{-6}$, or one cancer in a population of 1 million. These concentrations are very conservative (low) and are often well below analytical detection limits. Methodologies for determining human health criteria are discussed in detail by EPA (1980).

As of this writing there are no EPA or FDER standards for pollutants in sediments.

## 4.2 ANALYTICAL RESULTS

Sample collection and in situ measurements were performed between November 29 and December 3, 1983. Results of analyses are given in Tables 8 through 12. All samples were returned to the WAR laboratory for

Table 7. Relevant EPA Water Quality Criteria (Page 1 of 3)

| Parameter | Criteria for Saltwater Aquatic Life, ug/l: Acute Toxicity Level | Criteria for Saltwater Aquatic Life, ug/l: Chronic Toxicity Level* | Criteria for Saltwater Aquatic Life, ug/l: Maximum 24-hr. Average | Criteria for Saltwater Aquatic Life, ug/l: Maximum Concentration | Human Health Criteria, ug/l: Potable Water Taste/Odor Control†† | Human Health Criteria, ug/l: Ingestion of Water and Aquatic Organisms: Ambient Criterion | Human Health Criteria, ug/l: Ingestion of Water and Aquatic Organisms: $10^{-6}$ Incremental Cancer Risk |
|---|---|---|---|---|---|---|---|
| HEAVY METALS | | | | | | | |
| Cadmium | | | 4.5 | 59 | | 10 | |
| Chromium, trivalent | 10,300 | | | | | 170,000 | |
| Chromium, hexavalent | | | 18 | 1,260 | | 50 | |
| Lead | 668 | 25 | | | | 50 | |
| Nickel | | | 7.1 | 140 | | 13.4 | |
| Zinc | | | 58 | 170 | 5,000 | | |
| VOLATILE HALOCARBONS | | | | | | | |
| Carbon tetrachloride | 50,000 | | | | | 0** | 0.40 |
| Chlorinated benzenes | 160 | 129 | | | | 0** | 0.0072 |
| Chlorinated ethanes | | | | | | | |
| 1,2-dichloroethane | 113,000 | | | | | 0** | 0.94 |
| 1,1,1-trichloroethane | 31,200 | | | | | 18.4 | |
| 1,1,2-trichloroethane | | | | | | 0** | 0.60 |
| Chloroform | | | | | | 0** | 0.19 |
| Dichlorobenzenes | 1,970 | | | | | 400 | |
| Dichloropropenes | 790 | | | | | 14.1 | |
| Holomethanes | 12,000 | 6,400 | | | | 0** | 0.19 |
| Vinyl chloride | | | | | | 0** | 2.0 |
| VOLATILE AROMATICS | | | | | | | |
| Benzene | 5,100 | 700† | | | | 0** | 0.66 |
| Ethyl benzene | 430 | | | | | 1.4 | |
| Toluene | 6,300 | 5,000 | | | | 14.3 | |

Table 7. Relevant EPA Water Quality Criteria (Page 2 of 3)

| Parameter | Criteria for Saltwater Aquatic Life, ug/l: Acute Toxicity Level | Chronic Toxicity Level* | Maximum 24-hr. Average | Maximum Concentration | Human Health Criteria, ug/l: Potable Water Taste/Odor Control†† | Ingestion of Water and Aquatic Organisms: Ambient Criterion | $10^{-6}$ Incremental Cancer Risk |
|---|---|---|---|---|---|---|---|
| PHENOLIC COMPOUNDS | | | | | | | |
| CHLORINATED PHENOLS | | | | | | | |
| 2,3,5,6-tetrachlorophenol | 440 | | | | | | |
| 4-chlorophenol | 29,700 | | | | | | |
| 3-monochlorophenol | | | | | 0.10 | | |
| 4-monochlorophenol | | | | | 0.10 | | |
| 2,3-dichlorophenol | | | | | 0.04 | | |
| 2,5-dichlorophenol | | | | | 0.50 | | |
| 2,6-dichlorophenol | | | | | 0.20 | | |
| 3,4-dichlorophenol | | | | | 0.30 | | |
| 2,3,4,6-tetracholorophenol | | | | | 1.0 | | |
| 2,4,5-trichlorophenol | | | | | 1.0 | 2,600 | |
| 2,4,6-trichlorophenol | | 970 | | | 2.0 | 0** | 1.2 |
| 2-methyl-4-chlorophenol | | | | | 1,800 | | |
| 3-methyl-4-chlorophenol | | | | | 3,000 | | |
| 3-methyl-6-chlorophenol | | | | | 20 | | |
| 2-chlorophenol | | | | | 0.10 | | |
| 2,4-dichlorophenol | | | | | 0.30 | 3.09 | |
| 2,4-dimethylphenol | | | | | 400 | | |

Table 7. Relevant EPA Water Quality Criteria (Page 3 of 3)

| Parameter | Criteria for Saltwater Aquatic Life, ug/1: Acute Toxicity Level | Chronic Toxicity Level* | Maximum 24-hr. Average | Maximum Concentration | Human Health Criteria, ug/1: Potable Water Taste/Odor Control†† | Ingestion of Water and Aquatic Organisms: Ambient Criterion | $10^{-6}$ Incremental Cancer Risk |
|---|---|---|---|---|---|---|---|
| Nitrophenols | 4,850 | | | | | | |
| 2,4-dinitro-o-cresol | | | | | | 13.4 | |
| dinitrophenol | | | | | | 70 | |
| Pentachlorophenol | 53 | 34 | | | 30 | 1,010 | |
| Phenol | 5,800 | | | | 0.30 | 3.5 | |

*Toxicity may occur at lower concentrations among species more sensitive than those tested.
†Data are not definitive; adverse chronic effects were observed at this concentration with exposure time of 168 days.
**Zero level may not be attainable.
††Organoleptic data used as basis for taste and odor control have no demonstrated relationship to adverse human health effects.

Source: EPA, 1980.

Table 8. Analytical Results, Zone 1

| Sample Location No. | Sample Type | pH | Temp. °C | Spec. Cond. umho/cm | DOC mg/l | TOX ug Cl/l* | Total Phenolics, ug/l | Metals, ug/l (water) or ug/kg dry weight (sediment) | | | | | | Total DDTR ug/kg Dry Weight† |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Cd | Cr | Fe | Ni | Pb | Zn | |
| T1-1 | Groundwater | 6.8 | 22.5 | 860 | 28 | 2,900 | 6 | <5 | <10 | 510 | <20 | <30 | <10 | - |
| T1-2 | Groundwater | 6.8 | 22 | 810 | 22 | 400 | 9 | <5 | <10 | 190 | <20 | <30 | 45 | - |
| T1-3 | Groundwater | 7.0 | 21.5 | 720 | 24 | 3,100 | 3 | <5 | <10 | 46 | 29 | <30 | <10 | - |
| T1-4 | Groundwater | 6.2 | 24 | 332 | 17 | 140 | 18 | <5 | 10 | 44,400 | <20 | <30 | <10 | - |
| T1-5 | Groundwater | 5.9 | 21 | 123 | 69 | 130 | 91 | <5 | 11 | 690 | <20 | <30 | 18 | - |
| T1-6 | Groundwater | 6.2 | 21.5 | 365 | 17 | 170 | 18 | <5 | <10 | 49,900 | <20 | <30 | <10 | - |
| T1-6 | Groundwater†† | - | - | - | 19 | 160 | 18 | <5 | <10 | 44,400 | <20 | <30 | 12 | - |
| T1-EW | Groundwater | 6.8 | 16 | 297 | 15 | 150 | 7 | <5 | <10 | 3,000 | <20 | <30 | 20,200 | - |
| T1-SW1 | Surface water | 6.5 | 17 | 91 | 9 | 100 | 9 | <5 | <10 | 68 | <20 | <30 | 110 | - |
| T1-SW2 | Surface water | 6.0 | 20 | 185 | 12 | 120 | 9 | <5 | <10 | 3,200 | 22 | <30 | 74 | - |
| T1-SW3 | Surface water | 6.5 | 19.5 | 202 | 10 | 1,800 | 11 | <5 | <10 | 2,100 | 20 | 33 | 14 | - |
| T1-SW4 | Surface water | 6.5 | 20 | 231 | 11 | 120 | 11 | <5 | 11 | 7,240 | <20 | <30 | <10 | - |
| T1-SED1 | Sediment | - | - | - | - | 3,500 | - | <50 | 810 | 169,000 | 200 | 830 | 1,150 | 11.4 |
| T1-SED2 | Sediment | - | - | - | - | 5,200 | - | <50 | 2,880 | 272,000 | <190 | 11,500 | 2,020 | 12.4 |
| T1-SED2 | Sediment†† | - | - | - | - | 3,700 | - | - | - | - | - | - | - | - |
| T1-SED3 | Sediment | - | - | - | - | 3,400 | - | <50 | 1,000 | 1,800,000 | 220 | 490 | 800 | 6.8 |

*Sediment samples are reported as ug Cl/kg dry weight.
†Analytical results for individual DDTR metabolites are given in Table 12.
††Field duplicate.

Table [illegible]. Analytical Results, Zones 2, 3, 4, and 5

| Sample Location No. | Sample Type | pH | Temp. °C | Spec. Cond. umho/cm | DOC mg/l | TOX ug Cl/l | Chromium ug/l | Lead ug/l | Oil and Grease mg/l | VOA* ug/l | VOH† ug/l | Depth of Fuel Layer, cm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH2-1 | Groundwater | 6.3 | 21.5 | 30 | 123 | 110 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-2 | Groundwater | 4.6 | 21 | 51 | <0.30 | 100 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-3 | Groundwater | 7.8 | 21 | 310 | 2 | 110 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-4 | Groundwater | 6.1** | 21 | 426 | 7 | 90 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-5 | Groundwater | 6.2** | 22 | 184 | 4 | 320 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-6 | Groundwater | 5.7** | 23 | 287 | 7 | 140 | - | <30 | <0.10 | - | - | 0.0 |
| LH2-6 | Groundwater†† | - | - | - | - | 140 | - | <30 | <0.10 | - | - | - |
| LH2-7 | Groundwater | 5.1** | 22 | 125 | 35 | 130 | - | <30 | <0.10 | - | - | 0.0 |
| T3-1 | Groundwater | 5.7 | 20.5 | 124 | 2 | 90 | - | <30 | <0.10 | - | - | - |
| T3-1 | Groundwater†† | - | - | - | - | 110 | - | - | 0.30 | - | - | - |
| T3-2 | Groundwater | 5.6 | 21.5 | 105 | <0.30 | 90 | - | <30 | <0.10 | - | - | - |
| T3-3 | Groundwater | 5.9 | 20.5 | 184 | 2 | 90 | - | 34 | 1.8 | - | - | - |
| T3-4 | Groundwater | 6.2 | 19 | 415 | 14 | 140 | - | <30 | 0.4 | - | - | - |
| T3-EW | Groundwater | 7.0 | 22.5 | 310 | - | - | - | - | - | 1 | 42 | - |
| T4-1 | Groundwater | - | - | - | - | - | - | - | - | - | - | 0.0 |
| T5-1 | Groundwater | 5.4 | 22.5 | 78 | 2 | 80 | <10 | <30 | - | - | - | - |
| T5-2 | Groundwater | 4.6 | 22 | 172 | <0.30 | 100 | <10 | <30 | - | - | - | - |
| T5-3 | Groundwater | 5.5 | 22 | 230 | 2 | 100 | <10 | <30 | - | - | - | - |
| T5-3 | Groundwater†† | - | - | - | 2 | 120 | <10 | <30 | - | - | - | - |

*VOA = Volatile aromatics, total of four constituents. Analytical results for individual constituents are given in Table 11.
†VOH = Volatile halocarbons, total of 28 constituents. Analytical results for individual constituents are given in Table 11.
**pH reading taken in lab; meter malfunctioned in field.
††Field duplicate.

Table 10. Analytical Results, Zones 6, 7, 8, 9 and 10

| Sample Location No. | Sample Type | pH | Temp. °C | Spec. Cond. umho/cm | DOC mg/l | TOX ug Cl/l | Total Phenolics, ug/l | Chromium ug/l | Lead ug/l | Zinc ug/l | VOA* ug/l | VOH† ug/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T6-1 | Groundwater | 6.2 | 20 | 233 | 32 | - | 32 | - | <30 | - | 71 | 39 |
| T6-2 | Groundwater | 4.5 | 21 | 65 | 75 | - | 62 | - | <30 | - | <6 | 30 |
| T6-3 | Groundwater | 6.2 | 21 | 248 | 38 | - | 54 | - | 31 | - | 1,132 | 247 |
| T6-3 | Groundwater** | - | - | - | 116 | - | 47 | - | <30 | - | 539 | 94 |
| T7-1 | Groundwater | 4.6 | 20 | 69 | 175 | - | 6 | - | <30 | - | <6 | 31 |
| T7-2 | Groundwater | 4.5 | 19.5 | 60 | 18 | - | 4 | - | <30 | - | <6 | 18 |
| T7-3 | Groundwater | 4.5 | 20.5 | 90 | 141 | - | 8 | - | <30 | - | <6 | 21 |
| T7-3 | Groundwater** | - | - | - | 171 | - | 8 | - | <30 | - | - | - |
| T7-EW | Groundwater | 7.1 | 20.5 | 1,090 | <0.30 | - | 1 | - | <30 | - | 2 | 133 |
| T8-1 | Groundwater | 6.8 | 20 | 382 | 36 | 150 | 10 | <10 | <30 | 12 | - | - |
| T8-2 | Groundwater | 5.2 | 20 | 71 | 1 | 80 | 14 | <10 | <30 | 22 | - | - |
| T9-1 | Groundwater | 4.8 | 23 | 95 | 102 | 220 | - | - | <30 | - | - | - |
| T9-2 | Groundwater | 5.3 | 20.5 | 72 | 9 | 110 | - | - | <30 | - | - | - |
| T10-1 | Groundwater | 7.4 | - | - | 5 | 120 | 6 | - | <30 | - | - | - |
| T10-2 | Groundwater | 7.1 | - | - | 7 | 170 | 8 | - | <30 | - | - | - |
| T10-3 | Groundwater | 7.3 | 20.5 | 128 | 7 | 140 | 8 | - | <30 | - | - | - |
| T10-4 | Groundwater | 7.8 | 20.5 | 231 | 5 | 130 | 13 | - | <30 | - | - | - |

*VOA = Volatile aromatics, total of four constituents. Analytical results for individual constituents are given in Table 11.
†VOH = Volatile halocarbons, total of 28 constituents. Analytical results for individual constituents are given in Table 11.
**Field duplicate.

Table 11. Results of Purgeable Organics Analyses (Page 1 of 2)

| Constituents | Zone 3 | Zone 6 | | | | Zone 7 | | | | Detection |
|---|---|---|---|---|---|---|---|---|---|---|
| | T3-EW | T6-1 | T6-2 | T6-3 | T6-3(D) | T7-1 | T7-2 | T7-3 | T7-EW | Limit ug/l |
| **Volatile Halocarbons** | | | | | | | | | | |
| Bromodichloromethane | ND | ND | ND | 4 | ND | ND | ND | ND | ND | 1 |
| Bromoform | ND | ND | ND | ND | ND | ND | ND | ND | 97 | 3 |
| Bromomethane | ND | ND | 5 | ND | ND | ND | ND | ND | ND | 5 |
| Carbon tetrachloride | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Chlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Chloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| 2-Chloroethylvinyl ether | ND | ND | ND | ND | ND | ND | ND | ND | ND | 3 |
| Chloroform | 9 | ND | ND | 3 | ND | ND | ND | ND | ND | 1 |
| Chloromethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | 5 |
| Dibromochloromethane* | ND | ND | ND | ND | ND | ND | ND | ND | ≤3* | 1 |
| 1,2-Dichlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| 1,3-Dichlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| 1,4-Dichlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Dichlorodifluoromethane† | ND | ND | ND | 133 | 84 | ND | ND | ND | 12 | 1 |
| 1,1-Dichloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| 1,1-Dichloroethene | 1 | 1 | 1 | ND | 5 | ND | ND | ND | ND | 1 |
| 1,2-Dichloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Trans-1,2-Dichloroethene | ND | 6 | ND | 10 | 5 | ND | ND | ND | ND | 1 |
| Cis-1,3-Dichloropropene* | ND | ND | ND | ND | ND | ND | ND | ND | ≤3* | 1 |
| Trans-1,3-Dichloropropene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Methylene chloride | 24 | 22 | 17 | 84 | ND | 17 | 12 | 15 | 9 | 1 |
| Tetrachloroethene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| 1,1,1-Trichloroethane | 8 | 10 | 7 | 13 | ND | 7 | 6 | 6 | 8 | 1 |
| 1,1,2-Trichloroethane* | ND | ND | ND | ND | ND | ND | ND | ND | ≤3* | 1 |
| 1,1,2,2-Tetrachloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Trichloroethene | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| Trichlorofluoromethane | ND | ND | ND | ND | ND | 7 | ND | ND | 4 | 1 |
| Vinyl chloride† | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1 |
| TOTAL VOLATILE HALOCARBONS (Sum of above constituents) | 42 | 39 | 30 | 247 | 94 | 31 | 18 | 21 | 133 | |

Table 11. Results of Purgeable Organics Analyses (Page 2 of 2)

| Constituents | Zone 3 | Zone 6 | | | | Zone 7 | | | | Detection |
|---|---|---|---|---|---|---|---|---|---|---|
| | T3-EW | T6-1 | T6-2 | T6-3 | T6-3(D) | T7-1 | T7-2 | T7-3 | T7-EW | Limit ug/l |
| Volatile Aromatics | | | | | | | | | | |
| Benzene | 1 | 12 | ND | 94 | 35 | ND | ND | ND | 2 | 1 |
| Ethyl benzene | ND | ND | ND | 68 | 32 | ND | ND | ND | ND | 1 |
| Toluene | ND | ND | ND | ND | 2 | ND | ND | ND | ND | 1 |
| Xylenes | ND | 59 | ND | 970 | 470 | ND | ND | ND | ND | 3 |
| TOTAL VOLATILE AROMATICS (Sum of above constituents) | 1 | 71 | ND | 1,132 | 539 | ND | ND | ND | 2 | |
| TOTAL PURGEABLE ORGANICS | 43 | 110 | 30 | 1,379 | 633 | 31 | 18 | 21 | 135 | |

NOTES: All results reported in ug/l.
ND = Not detected.

*The compounds dibromochloromethane, cis-1,3-dichloropropene, and 1,1,2-trichloroethane coelute using these methodologies and cannot be differentiated. The total concentration for the sum of these three compounds is 3 ug/l.

†The compounds dichlorodifluoromethane and vinyl chloride coelute using these methodologies and cannot be differentiated. Peaks eluting at a time consistant with these compounds have been identified as dichlorodifluoromethane due to this compound's greater stability and its common usage.

Table 12. Results of DDTR Analyses, Zone 1 Sediments

| Sample Location Number | Concentrations of DDTR Metabolites, ug/kg Dry Weight | | | | | | Total DDTR |
|---|---|---|---|---|---|---|---|
| | o,p DDD | p,p'DDD | o,p DDE | p,p'DDE | o,p DDT | p,p'DDT | |
| T1-SED1 | <0.10 | 1.9 | <0.10 | 2.2 | 0.4 | 6.9 | 11.4 |
| T1-SED2 | <0.10 | 6.8 | <0.10 | 4.1 | <0.10 | 1.5 | 12.4 |
| T1-SED3 | <0.10 | 4.7 | <0.10 | 1.5 | <0.10 | 0.6 | 6.8 |

preparation of quality control spikes and assignment of sample numbers. Samples were then shipped to subcontractor laboratories for analyses. Analyses for TOX were performed by Utah Biomedical Testing Labs (UBTL), a division of the University of Utah Research Institute in Salt Lake City, Utah. All other analyses were performed by Technical Services, Inc. (TSI) of Jacksonville, Florida. Analytical methods used and detection limits attained are listed in Table E-1, Appendix E. Analytical quality control is discussed in Appendix E.

## 4.3 DISCUSSION OF RESULTS

### 4.3.1 General

Results of analyses on environmental samples collected during the Tyndall AFB Phase IIb survey are discussed in terms of relevant water quality standards and criteria whenever possible. All groundwater sampled during the survey is classified G-II by the state of Florida, and must conform to MCLs established by Florida drinking water regulations. Of the parameters analyzed in this survey, MCLs are established for cadmium, chromium, iron, lead, zinc, pH, and total THMs (see Table 4). Florida drinking water MCLs are identical to MCLs established by EPA interim drinking water regulations for the parameters analyzed.

Where MCLs are not available for direct comparison, Florida or EPA criteria for surface water nearest the site can be used to compare with groundwater quality. This is an indirect comparison, and in order to estimate the potential impact of groundwater quality on the receiving surface water the following factors must be taken into account:

1. Rate of migration of the contaminant from shallow groundwater to the adjacent surface water; and
2. Fate of the contaminant once it reaches the surface water (i.e., degree of dispersion or mixing, degree of dissolution, adsorption on sediments or vegetation, etc.).

With the limited data available at Tyndall AFB disposal sites, these factors cannot be quantified. Thus, if groundwater concentrations of

pollutants exceed adjacent surface water criteria it cannot be said with certainty that the surface water will be adversely impacted. However, if groundwater parameters are within adjacent surface water criteria, it can be stated with certainty that the surface water criteria will not be exceeded due to local groundwater discharge. Florida surface water criteria are listed in Table 6 for chromium, lead, oil and grease, pH, phenolic compounds (particularly chlorinated phenolics), specific conductance, cadmium, iron, nickel, DDT, and zinc.

The Florida general surface water criterion for chlorinated phenolics is 1 ug/l. EPA has established water quality criteria for 21 specific phenolic compounds, as listed in Table 7. These criteria can be used for comparison with total phenolic data only to determine whether the potential exists for criteria to be exceeded. If the total phenolic concentration of a water sample exceeds a criterion for a specific phenolic compound or group of phenolic compounds, then the potential exists for that criterion to be exceeded.

EPA water quality criteria are listed in Table 7 for metals, purgeable organics, and phenolic compounds. EPA water quality criteria are not established for all purgeable organic compounds analyzed in the Tyndall AFB Phase IIb survey. For detected compounds without criteria, published toxicity data are used to assess potential environmental and human health hazards.

There are no criteria or standards for direct evaluation of TOX data. If used in a rigorous manner (e.g., RCRA groundwater compliance monitoring), extensive background data are required to determine statistically whether monitoring well levels are significantly higher than background well levels. When used as a screening indicator, as is the case with the Tyndall AFB Phase IIb survey, such data are not available. For the purposes of interpreting TOX data reported in this survey, a TOX concentration of 40 ug Cl/l was selected as being sufficiently high to indicate a positive screening test. This concentration is based on the

Florida/EPA MCL for THMs which is 100 ug/l for the sum of bromoform, chloroform, bromodichloromethane, and dibromochloromethane concentrations. Molecular weights for these species range from 119.4 for chloroform to 252.8 for bromoform. A chloroform concentration of 100 ug/l would be equivalent to 89 ug Cl/l reported as TOX, the ratio of the chloride weight (3 X 35.5 = 106.5) to the molecular weight (119.4). A bromoform concentration of 100 ug/l would be equivalent to 42 ug Cl/l reported as TOX, the ratio of the halogen weight reported as chlorine (3 X 35.5 = 106.5) to the molecular weight (252.8). The cut-off level for TOX, 40 ug Cl/l, was based on the concentration of bromoform that could be present in a sample without exceeding the 100 ug/l THM standard. A TOX concentration of 40 ug Cl/l corresponds to a range of 45 ug/l (all chloroform) to 95 ug/l (all bromoform) total THMs and is four times the reported detection limit for the analysis. These comparisons are based on molecular weight considerations only and assume 100 percent accuracy of analytical methods.

Tyndall AFB Phase IIb TOX results indicate the possibility of a positive interference in the analysis. If present, this positive interference is probably due to the presence of inorganic halides (e.g., chlorides) in the samples. The TOX analysis was developed as a screening analysis for drinking water and was adopted by EPA for landfill monitoring without additional testing on the basis that it was the best available method (Harper, 1984; Dressman, 1984). It has since been found that the TOX analysis is subject to positive matrix interferences, particularly inorganic halides (Dressman, 1984). Documentation on the magnitude of these interferences is not currently available in the literature. TOX data at Tyndall AFB are insufficient to quantify positive TOX interference. Inspection of the Tyndall AFB data indicates that most TOX analyses fall in the range of 80 to 220 ug Cl/l, with only five water samples above this range. Some or all of the TOX in this range could be a result of positive interference. Since the data are insufficient to verify the presence of interferences or to quantify their magnitude, the TOX results reported herein will be interpreted as a positive or negative

screening analysis, based on the 40 ug Cl/l criterion discussed above. In nearly all cases, additional analyses will be required to verify the presence of TOX contamination. Further discussion of suspected TOX interferences is given in Appendix E.

There are no criteria or standards for direct evaluation of DOC data. Background DOC concentrations in natural water samples can vary widely, depending primarily on decomposition of organic matter in the soil. DOC data for this survey are evaluated subjectively as an indication of general organic contamination.

#### 4.3.2 Zone 1, Main Base Landfills

All cadmium concentrations for surface water, groundwater, and sediment are below the detection limit of 5 ug/l (ug/kg dry weight for sediments). This detection limit is below the MCL of 10 ug/l established for drinking water by EPA and FDER.

Chromium was detected at or near the detection limit of 10 ug/l in two groundwater samples and one surface water sample. These levels are well below the drinking water MCL of 50 ug/l. Chromium was detected in all four sediment samples at levels ranging from 200 to 2,880 ug/kg dry weight. These levels are within the range of expected natural background.

Iron levels in samples from four of six wells exceed the MCL for iron in drinking water, 300 ug/l. Iron levels were highest in wells downgradient from the Sprayfield Vicinity Landfill, where a value of 44,400 ug/l and a mean of 47,000 ug/l were reported for well Nos. T1-4 and T1-6, respectively (see Figure 5). The sample from well No. T1-5, located between these wells and farther downgradient from the landfill contained 690 ug/l iron. Of the three wells at the Sewage Plant Vicinity Landfill, only one (No. T1-1, 510 ug/l) exceeded the MCL for iron.

Surface water samples from the drainage ditch dividing the two landfills indicated some leaching of iron. Sample T1-SW1, upstream of the landfill, contained 68 ug/l iron. The three downstream samples contained 3,200, 2,100, and 7,200 ug/l iron. All downstream samples exceeded the Florida criterion for Class III surface waters, 1.0 mg/l. The drainage ditch discharges to the Gulf of Mexico, a Class III water. However, the small base flow from the ditch should be rapidly dispersed and diluted once reaching the Gulf of Mexico, and should not adversely affect iron levels beyond a small zone near the ditch outfall. Iron levels in the ditch sediments ranged from 169 to 1,797 mg/kg dry weight and are within expected natural background conditions.

Nickel was detected in one of six well samples (T1-3) at a concentration of 29 ug/l. This is only slightly above the reported detection limit of 20 ug/l. Though there is no drinking water MCL for nickel, the reported value is well within the Florida criterion for Class II and III surface waters, 100 ug/l. Nickel was detected in two of the three ditch sediment samples (T1-SED1 and T1-SED3) slightly above the detection limit of 190 ug/kg dry weight. These concentrations are within the range of expected natural background.

Lead was not detected in any groundwater samples. The detection limit reported for lead is 30 ug/l, below the drinking water MCL of 50 ug/l. A concentration of 33 ug/l was reported for lead in the surface water sample at location T1-SW3. This is the only detectable quantity of lead reported for water samples in Zone 1. Though it exceeds the Florida Class III water quality criterion (30 ug/l) for the receiving water, the low lead concentration combined with the small base flow of the ditch will not have a significant effect on lead levels in the Gulf of Mexico.

Lead concentrations of the four ditch sediment samples ranged from 190 to 11,500 ug/kg dry weight. These levels are within the range of expected natural background.

Zinc concentrations in all downgradient monitoring well locations (T1-1 through T1-6) were below the drinking water MCL of 5,000 ug/l. The sample from the existing sewage sprayfield monitoring well (T1-EW) contained 20,200 ug/l zinc, approximately four times the MCL. High concentrations in this well are probably a result of the galvanized well casing. Limited data from wells downgradient from well location T1-EW (well locations T1-4, T1-5 and T1-6) do not indicate significant levels of zinc in the shallow groundwater. Zinc concentrations at the two upstream surface water sampling locations (T1-SW1, 110 ug/l; and T1-SW2, 74 ug/l) exceed the Florida Class III water quality criterion for zinc, 30 ug/l. The source of the zinc may be the sewage sprayfield. Downstream surface water zinc concentrations (T1-SW3 and T1-SW4) are well below the criterion, indicating that zinc is not being discharged from the ditch in significant quantities. Sediment zinc levels range from 800 to 2,020 ug/kg dry weight and are within the range of expected natural background.

Total phenolics in Zone 1 well and surface water samples range from 3 to 91 ug/l. Florida general surface water criterion are 1 ug/l for specific listed chlorinated phenolics. Likewise EPA has established acute and chronic saltwater aquatic life toxicity levels of 53 ug/l and 34 ug/l, respectively for pentachlorophenol. Since the total phenolics concentration in some samples from Zone 1 exceeds these criteria, it is possible that the specific chlorinated phenolic compounds of interest are present at levels of concern. However, in the absence of information regarding which specific phenolic compounds make up the totals measured, it is impossible to determine if any criteria are exceeded.

Total DDTR (DDT and its metabolites listed in Table 12) range from 6.8 to 12.4 ug/kg dry weight from the three Zone 1 sediment samples. Concentrations of individual isomers range from less than 0.10 to 6.9 ug/kg dry weight. At these low sediment concentrations it is unlikely that DDT would be present in detectable quantities in the overlying ditch waters due to its low solubility and tendency to adsorb to sediments.

Screening analyses for TOX were positive for all Zone 1 samples, with all concentrations exceeding 100 ug Cl/l. TOX in samples from well Nos. T1-1, T1-2, and T1-3 was detected at concentrations of 2,900, 400, and 3,100 ug Cl/l, respectively. These wells are screened to a depth 4 to 6 feet below msl and may be showing results of positive chloride interference in the TOX analysis. The sample from surface water location T1-SW3 contained 1,800 ug Cl/l TOX. TOX levels in the ditch sediments ranged from 3,400 to 5,200 ug Cl/kg dry weight.

DOC concentrations for all Zone 1 water samples with the exception of well No. T1-5 varied from 9 to 28 mg/l, within the range of expected natural background conditions. The elevated value of 69 mg/l from well No. T1-5 may indicate the presence of organic contamination.

Specific conductance of water samples ranged from 91 to 860 umho/cm. Wells with the highest values (Nos. T1-1, T1-2, and T1-3) are in close proximity to the adjacent estuary and are screened to a depth 4 to 6 feet below msl, thus may be showing the effects of salt water intrusion. This may be occurring to a lesser extent in well No. T1-5, which is screened to a depth of 0.5 feet below msl. Well Nos. T1-4 and T1-6 are screened to depths of 5 and 3.5 feet above msl and should not be subject to significant salt water intrusio . Data for surface water samples indicate that at least some of the observed specific conductance in Zone 1 groundwater may be attributed to landfill leachate. Specific conductance of all ditch surface water samples downstream from the landfill boundary (T1-SW2, T1-SW3, and T1-SW4) are more than double the value reported for the station upstream of the landfill (T1-SW1). The ditch bottom between T1-SW1 and T1-SW4 is approximately 6 to 8 feet above msl indicating that elevated specific conductance in the ditch water is probably not due to tidal influences.

All pH values reported for Zone 1 samples are within the range of expected natural background conditions.

### 4.3.3 Zone 2, Lynn Haven DFSP

Lead, oil and grease, and visible fuel layers were not detected in any Zone 2 wells.

TOX screening analyses for Zone 2 were positive at all wells, with concentrations in the range of 90 to 320 ug Cl/l. These wells are screened to depths varying from 2.7 to 6.2 feet below msl and may be showing effects of salt water intrusion and positive interference in the TOX analysis. DOC at well No. LH2-1 was detected at 123 mg/l and may indicate the presence of fuel contamination from the Bunker C disposal area; however, there was no visible fuel or detectable oil and grease in samples from this well. This apparent discrepancy may be a result of the difficulty in obtaining representative samples from the monitoring wells. Floating fuels may be collected in the first bailer or first sample poured from the bailer, but may not be collected in subsequent samples. Specific conductance varied from 30 to 426 umho/cm in the seven wells. There is no evidence that this range exceeds natural background conditions. The pH range of 4.6 to 7.8 is consistent with the expected range of natural background conditions.

### 4.3.4 Zone 3, POL Area "A"

TOX screening analyses were positive for all Zone 3 monitoring wells, ranging from 90 to 140 ug Cl/l. These wells are screened to depths varying from 1.6 to 6.7 feet below msl and may be showing effects of salt water intrusion and positive interference in the TOX analysis.

Specific conductance (range of 105 to 415 umho/cm) and pH (range of 5.6 to 7.0) are within the expected range of natural background conditions for these parameters. The maximum DOC value recorded, 14 mg/l at well No. T3-4, is within the range of expected natural background conditions. All other DOC values in Zone 3 are below 2 mg/l. Lead was detected in well No. T3-3 at a concentration of 34 ug/l, only slightly above the detection limit of 30 ug/l and well below the MCL of 50 ug/l. Lead was not detected in the other three Zone 3 monitoring wells. These

data do not indicate migration of significant quantities of lead from the sludge disposal area.

Oil and grease was detected in three of four monitoring wells at concentrations below the Florida general surface water criterion of 5 mg/l. The highest oil and grease value reported for Zone 3 is 1.8 mg/l in well No. T3-3. All other values are below 0.4 mg/l.

The concentration of total purgeable organics reported for well No. 6A (location T3-EW) is 44 ug/l. Concentrations of detectable constituents are as follows: chloroform, 9 ug/l; 1,1-dichloroethene, 1 ug/l; methylene chloride, 24 ug/l; 1,1,1-trichloroethane, 8 ug/l; and benzene, 1 ug/l. Chloroform is well below the MCL of 100 ug/l for THMs. Though federal or state criteria have not been established for 1,1-dichloroethene, it is expected to have toxicological properties similar to those for trichloroethene and 1,2-dichloroethane. Available toxicological data for these compounds do not indicate any acute or chronic toxicological effects at concentrations as low as 1 ug/l (Sax, 1983). Methlyene chloride is not acutely or chronically toxic to humans at a concentration of 24 ug/l (Sax, 1979). The 1,1,1-trichloroethane concentration of 8 ug/l is below the EPA ambient water quality criterion for human health, 18.4 ug/l. The benzene concentration of 1 ug/l is slightly above the detection limit (1 ug/l) and is well below the recommended drinking water limit of 4,500 ug/l (Sax, 1982). In summary, the detected levels of five purgeable organic constituents at potable well No. 6A do not indicate any human health hazard with regard to potable water supplies.

### 4.3.5 Zone 4, AAFES Service Station

Well No. T4-1, downgradient from the former leaking gasoline tank at the AAFES Service Station, was sampled to determine whether a visually detectable amount of fuel was present on the surface of the water table. Most of the leaking gas is believed to have been collected and removed by the storm sewer system. No fuel was visible in water bailed from the well.

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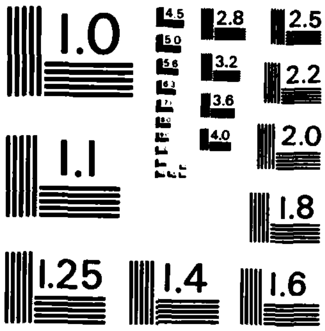


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### 4.3.6 Zone 5, Small Arms Repair Area

Chromium and lead were not detected in water samples from the three Zone 5 monitoring wells. Detection limits for the two metals were 10 and 30 ug/l, respectively; below the common MCL of 50 ug/l.

Specific conductance (range of 78 to 230 umho/cm) and pH (range of 4.6 to 5.5) are within the expected range of natural background conditions for these parameters. DOC concentrations range from less than 0.30 to 2 mg/l, well within the expected range of natural background. TOX screening analyses were positive for all three wells, ranging from 80 to 120 ug Cl/l.

### 4.3.7 Zone 6, Highway 98 Fire Training Area

Lead was detected in well No. T6-3 at a concentration ot 31 ug/l, below the MCL of 50 ug/l. Lead was not detected in the other two wells.

Concentrations of total purgeable organics in the three monitoring wells range from 30 to 1,379 ug/l. Bromodichloromethane and chloroform were detected in well No. T6-3 at concentrations of 4 and 3 ug/l, respectively; well below the THM MCL of 100 ug/l. Bromomethane was detected in well No. T6-2 (5 ug/l) and dichlorodifluoromethane was detected in both samples from well No. T6-3 (133 and 84 ug/l). Both are halomethanes for which the EPA chronic toxicity level for marine aquatic life is 6,400 ug/l. Human health criteria are not given for either compound. Dichlorodifluoromethane is expected to be similar to THMs with respect to toxicity and exceeds the MCL for THMs in one of two samples from well No. T6-3. Trans-1,2-dichloroethane and 1,1-dichloroethene were detected in all three Zone 6 wells at concentrations ranging from 1 to 10 ug/l. These compounds are expected to have toxicological properties similar to those for trichloroethene and 1,2-dichloroethane. Available toxicological data for the latter two compounds do not indicate any acute or chronic toxicological effects at concentrations as low as 10 ug/l (Sax, 1983). Methylene chloride was detected in all three monitoring wells at concentrations of 17 to 84 ug/l. Methylene chloride is not toxic to

humans in this concentration range (Sax, 1979). 1,1,1-trichloroethane was detected in all three wells at concentrations below the EPA ambient water quality criterion of 18.4 ug/l. Benzene was detected in all three wells at concentrations of 12 to 94 ug/l, well below the recommended drinking water limit of 4,500 ug/l (Sax, 1982). Ethyl benzene was detected in both samples from well No. T6-3 at concentrations of 66 and 32 ug/l. These concentrations exceed the EPA ambient water quality criterion of 1.4 ug/l. Toluene was detected in well No. T6-3 at a concentration of 2 ug/l, well below the EPA ambient criterion of 14.3 ug/l. Xylenes were detected in all three wells at concentrations of 59 to 970 ug/l. Though EPA criteria have not been established for xylenes, toxicological data for xylenes and toluene indicate that the two compounds have similar toxicological effects on laboratory animals (Sax, 1979). The xylene concentrations in Zone 6 wells indicate significant contamination.

Concentrations of total phenolics in Zone 6 wells range from 32 to 62 ug/l. These levels exceed the Florida general surface water criterion for chlorinated phenolics (1 ug/l), as well as several EPA surface water criteria for specific phenolic compounds (see Table 7). The hazard potential of total phenolics detected in Zone 6 wells cannot be fully assessed without additional analyses for specific phenolic compounds.

Specific conductance (range of 65 to 248 umho/cm) and pH (range of 4.5 to 6.2) are within the expected range of natural background conditions for these parameters. DOC concentrations for four samples from the three wells range from 32 to 116 mg/l. Elevated values for the sample from well No. T6-2 (75 mg/l) and one sample from well No. T6-3 (116 mg/l) indicate the presence of organic contamination.

During well installation soil samples from all depths below the surface sample had strong fuel odors. Water released from these samples showed a clearly visible oil sheen. TOX analyses were not performed on Zone 6 samples.

### 4.3.8 Zone 7, Southeast Runway Extension Burial Site

Lead was not detected in three monitoring wells and one existing potable water well in Zone 7. The detection limit reported for lead is 30 ug/l, below the MCL of 50 ug/l.

Total purgeable organics concentrations in the three Zone 7 monitoring wells range from 18 to 31 ug/l. Methylene chloride was detected in all three wells at concentrations of 12 to 17 ug/l, well below levels known to be toxic to humans or other life (Sax, 1979). Concentrations of 1,1,1-trichloroethane range from 6 to 7 ug/l in the three wells, well below the EPA ambient criterion of 18.4 ug/l. Trichlorofluoromethane was detected in well No. T7-1 at a concentration of 7 ug/l. The concentration of this halomethane is well below the EPA chronic toxicity level for marine aquatic life, 6,400 ug/l. Trichlorofluoromethane is expected to be similar to THMs with respect to toxicity, and the concentration reported for well No. T7-1 is well below the MCL for THMs. None of the four volatile aromatic compounds were detected in Zone 7 monitoring wells.

The sample from the potable water well at the alert facility (well No. 11, location T7-EW) contained 134 ug/l total purgeable organics. The sum of the concentrations of bromoform (97 ug/l) and dibromochloromethane (3 ug/l) equal the MCL for THMs (100 ug/l) in this well sample. Two other halomethanes, dichlorodifluoromethane (12 ug/l) and trichlorofluoromethane (4 ug/l) were also detected in this sample. Methylene chloride was detected in this sample at a concentration of 9 ug/l, below levels known to be toxic to humans (Sax, 1979). 1,1,2-trichloroethane was detected in this sample at a concentration of 8 ug/l, below the EPA ambient criterion of 18.4 ug/l. The benzene concentration of 2 ug/l is well below the recommended drinking water limit of 4,500 ug/l (Sax, 1982).

Concentrations of total phenolics in four samples from the three Zone 7 monitoring wells range from 4 to 8 ug/l. These levels exceed Florida general surface water criterion for chlorinated phenolics (1 ug/l) and

EPA ambient water quality criteria for 2,4-dichlorophenol (3.09 ug/l) and phenol (3.5 ug/l). Without additional analyses for specific phenolic compounds it cannot be determined if any criteria are exceeded. Total phenolics were detected in the existing potable water well at the alert facility (well No. T7-EW) at the detection limit of 1 ug/l. This concentration does not exceed any human health criteria for potable water.

Specific conductance (range of 60 to 90 umho/cm) and pH (range of 4.5 to 4.6) for Zone 7 samples are within the expected range of natural background conditions. DOC concentrations in the three wells range from 18 to 175 mg/l. Elevated DOC in well Nos. T7-1 (175 mg/l) and T7-3 (mean of 156 mg/l) indicate the possibility of organic contamination. Zone 7 well samples were not analyzed for TOX.

Specific conductance reported for the potable water well No. 11 (location T7-EW) is 1,090 umho/cm. This level is high enough to indicate that the secondary drinking water MCL for TDS (500 mg/l) may be exceeded. Elevated specific conductance in this well is probably due to salt water intrusion, the occurrence of which has been reported for this well prior to this survey. Plans are being considered to extend this well from its present depth of 115 feet to 450 feet to correct this problem. DOC was not detected in this well and the pH was nearly neutral (7.1).

### 4.3.9 Zone 8, "6000" Area Landfill

Neither chromium nor lead were detected in Zone 8 monitoring wells. Detection limits reported for chromium and lead were 10 and 30 ug/l, respectively; less than the common MCL of 50 ug/l. Zinc was detected in well Nos. T8-1 and T8-2 at concentrations of 12 and 22 ug/l, respectively. These concentrations are well below the zinc MCL of 5,000 ug/l.

Concentrations of total phenolics were 10 and 14 ug/l for well Nos. T8-1 and T8-2, respectively. These concentrations exceed the Florida general

surface water criterion for chlorinated phenolics (1 ug/l) as well as EPA criteria for several specific phenolic compounds (see Table 7).

Specific conductance (382 and 71 umho/cm), DOC (36 and 1 mg/l), and pH (6.8 and 5.2) for well Nos. T8-1 and T8-2, respectively are within the range of expected natural background for these parameters. TOX screening analyses were positive, with concentrations of 150 and 80 ug Cl/l reported for well Nos. T8-1 and T8-2, respectively.

4.3.10 <u>Zone 9, POL Area "B"</u>

Lead was not detected in either Zone 9 well sample. The detection limit for lead is 30 ug/l, below the MCL of 50 ug/l.

Specific conductance (95 and 72 umho/cm) and pH (4.8 and 5.3) for Zone 9 wells are within the range of expected natural background. DOC for the sample from well No. T9-1 is 102 mg/l, indicative of possible fuel contamination. DOC reported for well No. T9-2 is 9 mg/l. TOX screening analyses were positive for both Zone 9 wells, with concentrations of 220 and 110 ug Cl/l reported for well Nos. T9-1 and T9-2, respectively.

4.3.11 <u>Zone 10, Shell Bank Fire Training Area</u>

Lead was not detected in samples from the four Zone 10 backhoe pits. The detection limit of 30 ug/l is below the 50 ug/l MCL for lead.

Concentrations of total phenolics range from 6 to 13 ug/l in the four samples. These levels exceed the Florida general surface water criterion for chlorinated phenolics (1 ug/l) and EPA ambient water quality criteria for 2,4-dichlorophenol (3.09 ug/l) and phenol (3.5 ug/l). Without additional analyses for specific phenolic compounds, it cannot be determined if any criteria are exceeded.

Specific conductance (128 and 231 ug/l), pH (range of 7.1 to 7.8), and DOC (range of 5 to 7 mg/l) for Zone 10 groundwater samples are all within the range of expected natural background conditions. TOX screening

analyses were positive for all four samples, ranging from 120 to 170 ug Cl/l.

Exposed soil in the backhoe pits was examined for visual evidence of fuel contamination. Visual signs of contamination by fuels were not evident in any of the four backhoe pits.

### 4.4 SIGNIFICANT FINDINGS

#### 4.4.1 Zone 1, Main Base Landfills

Based on analyses of single samples from six monitoring wells down-gradient from the landfills and one existing well in the sewage sprayfield, four water samples from the drainage ditch bisecting the landfills, and three sediment samples within the ditch, the following significant findings are reported:

1. TOX screening analyses were positive for all Zone 1 samples, ranging from 120 to 3,100 ug Cl/l. These results may reflect positive interferences, the existence and magnitude of which cannot be determined with existing data. Elevated DOC in well No. T1-5 (69 mg/l) may indicate the presence of organic contamination in that well. Elevated specific conductance in well Nos. T1-1, T1-2, and T1-3 (range of 720 to 860 umho/cm) is believed to be caused in part by salt water intrusion. At least some of the specific conductance observed in Zone 1 groundwater is believed to be a result of landfill leachate. This is supported by specific conductance measurements on surface water samples from the drainage ditch dividing the landfills. The specific conductance of samples within the landfill (range of 185 to 231 umho/cm) is more than double the upstream value at T1-SW1 (91 umho/cm). The ditch bottom in this reach is approximately 6 to 8 feet above msl, thus tidal influences are not expected to account for this increase.
2. Total phenolic concentrations of all water samples in the range of 3 to 91 ug/l indicate that Florida and EPA water quality criteria for specific phenolic compounds may be exceeded.

3. Analytical results for cadmium, chromium, nickel, lead, and zinc indicate no significant contamination by these metals. All detected values in downgradient monitoring locations are below drinking water MCLs or other applicable criteria. Iron, though present in all Zone 1 samples in significant concentrations, does not present a contamination problem due to its low toxicity and rapid dilution anticipated in the adjacent Gulf of Mexico.
4. Concentrations of DDTR in sediment samples taken from the drainage ditch dividing the two Zone 1 landfills ranged from 6.8 to 12.4 ug/kg dry weight. At these low concentrations it is unlikely that DDTR would be detectable in the overlying waters due to its low solubility and tendency to adsorb to sediments.

### 4.4.2 Zone 2, Lynn Haven DFSP

Based on analyses of single samples from seven monitoring wells installed within the zone, the following significant findings are reported:

1. TOX screening analyses were positive for all seven wells, ranging from 90 to 320 ug Cl/l. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from existing data. High DOC concentrations at well No. LH2-1 (123 mg/l) indicate that some fuel contamination from the Bunker C disposal area may be present in that well. Measurements of specific conductance in all seven wells are within the expected range of natural background.
2. Oil and grease was below the detection limit of 0.10 mg/l in groundwater samples from all seven monitoring wells. There were no visible fuel layers present in any of the wells. These data indicate that there is no gross contamination of shallow groundwater by fuels within the zone.
3. Lead was not detected in any of the seven wells, indicating that leaded tank sludge disposal practices in Zone 2 have not resulted in significant migration of lead from the zone via shallow groundwater.

### 4.4.3 Zone 3, POL Area "A"

Based on analyses of single samples from four monitoring wells and one potable water well within the zone, the following significant findings are reported:

1. TOX screening analyses were positive for all four monitoring wells, ranging from 90 to 140 ug Cl/l. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from existing data.
2. A scan of 32 purgeable organics on a water sample from potable well No. 6A identified no human health hazards with regard to those compounds.
3. Lead was below detection limits in three monitoring wells and below the drinking water MCL in the fourth, indicating that leaded tank sludge disposal practices in Zone 3 have not resulted in significant migration of lead from the zone via shallow groundwater.
4. Oil and grease concentrations in the four monitoring wells are below the Florida general water quality criterion and do not indicate presence of gross fuel contamination in shallow groundwater.

### 4.4.4 Zone 4, AAFES Service Station

Based on visual examination of water bailed from the downgradient monitoring well, leakage from the gasoline tanks has not resulted in accumulation of fuel on top of the water table.

### 4.4.5 Zone 5, Small Arms Repair Area

Based on analyses of single samples from three monitoring wells installed within the zone, the following significant findings are reported:

1. TOX screening analyses were positive for all three wells, ranging from 80 to 120 ug Cl/l. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from existing data.

2. Neither chromium nor lead were detected in any groundwater samples, indicating that disposal of paint residues has not resulted in significant contamination of groundwater by these metals.

### 4.4.6 Zone 6, Highway 98 Fire Training Area

Based on analyses of single samples from three monitoring wells within the zone, the following significant findings are reported:

1. Shallow groundwater within the zone is contaminated with organic and phenolic compounds as a result of disposal and fire training practices within the zone. This finding is supported by the following ranges of contaminants: total phenolics, 32 to 62 ug/l; total purgeable organics, 31 to 1,380 ug/l; and DOC, 32 to 116 mg/l. Fuel odors were detected in all three wells at this site during installation and sampling. An oil sheen was visible on water removed from the wells during well installation.
2. Lead concentrations in samples from the three wells were below detection limits or below drinking water MCLs, indicating that fuel disposal/fire training practices have not resulted in significant lead contamination of shallow groundwater.

### 4.4.7 Zone 7, Southeast Runway Extension Burial Site

Based on analyses of single samples from three monitoring wells within the zone and one potable water well at the nearby alert facility, the following significant findings are reported:

1. Shallow groundwater may be contaminated by organic and phenolic compounds. This finding is supported by the following ranges for general screening parameters for the three monitoring wells: total phenolics, 4 to 8 ug/l (all wells); and DOC, 175 mg/l and 156 mg/l (well Nos. T7-1 and T7-3, respectively). Further sampling and analyses are required to assess this potential for contamination. Scans for 32 purgeable organics performed on all

three monitoring well samples indicated no significant contamination by these compounds.

2. A scan of 32 purgeable organics on a sample from the existing potable water well at the alert facility (well No. 11, sample location T-7 EW) indicated that the drinking water MCL for THMs (100 ug/l) was equaled. Specific conductance of the sample from this well was 1,090 umho/cm, sufficiently high to indicate that the MCL for TDS may be exceeded. High TDS in the potable well are most likely a result of salt water intrusion.
3. Lead was not detected in any of the four wells.

#### 4.4.8 Zone 8, "6000" Area Landfill

Based on single analyses of samples from two monitoring wells in the zone, the following significant results are reported:

1. TOX screening analyses were positive for both wells, with concentrations of 150 and 80 ug Cl/l reported for well Nos. T8-1 and T8-2, respectively. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from exiting data.
2. Total phenolic concentrations of 10 and 14 ug/l indicate that Florida and EPA water quality criteria for specific phenolic compounds may be exceeded.
3. Chromium and lead were not detected in either well sample. Zinc was detected in both samples at levels well below the drinking water MCL of 5 mg/l.

#### 4.4.9 Zone 9, POL Area "B"

Based on analyses of single samples from two monitoring wells within the zone, the following significant findings are reported:

1. TOX screening analyses were positive for both wells, with concentrations of 220 and 110 ug Cl/l reported for well Nos. T9-1 and T9-2, respectively. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from existing data. DOC for the sample

from well No. T9-1 was 102 mg/l and may indicate organic contamination in that well.

2. Lead was not detected in either well sample, indicating that leaded tank sludge disposal practices in Zone 9 have not resulted in significant lead contamination of shallow groundwater.

#### 4.4.10 Zone 10, Shell Bank Fire Training Area

Based on analyses of single groundwater samples from four backhoe test pits, the following significant findings are reported:

1. TOX screening analyses were positive for all four test pit samples, ranging from 120 to 170 ug Cl/l. These results may reflect positive interferences, the existence and magnitude of which cannot be determined from existing data.
2. Total phenolic concentrations in the range of 6 to 13 ug/l indicate that Florida or EPA criteria for specific phenolic compounds may be exceeded.
3. Lead concentrations in all four groundwater samples were below detection limits, indicating that fuel disposal/fire training practices have not resulted in significant lead contamination of shallow groundwater.

# 5.0 ALTERNATIVE MEASURES

## 5.0 ALTERNATIVE MEASURES

Three alternatives are possible for the sites investigated: (1) undertake corrective actions to mitigate the contamination; (2) conduct further monitoring to determine the need, if any, of cleanup; or (3) take no further action.

Alternative 1, mitigation, is appropriate where there is clear indication that present or future human or environmental problems will exist. The priority for actions would depend on the magnitude of the threat and whether that threat was current or future. Mitigative actions may include (but are not limited to ) removal, containment, treatment, or stabilization of the contamination.

Alternative 2, additional monitoring, is appropriate where insufficient evidence exists to place a site in either the Alternative 1 or 3 categories. This alternative should be utilized with care since there is some risk that delay could allow contamination to spread and worsen the problem. The goal should be to gather enough evidence in a timely manner to resolve the question of whether or not the site should be cleaned up.

Alternative 3, no further action, is appropriate for sites where there is little, if any, evidence to indicate that the site is or will ever be a source of significant contamination. This is a difficult decision in that one can never be absolutely sure no problem will ever exist at a site. However, reasonable judgements must be made so that resources can be allocated to sites that have the highest potential for environmental insult.

Alternative 2, additional monitoring, is judged to be the only appropriate alternative for eight of the 10 Phase IIb zones identified at Tyndall AFB. These zones are:

1. Zone 1, Main Base Landfills;
2. Zone 2, Lynn Haven DFSP;
3. Zone 5, Small Arms Repair Area;

4. Zone 6, Highway 98 Fire Training Area;
5. Zone 7, Southeast Runway Extension Burial Site;
6. Zone 8, 6000 Area Landfill;
7. Zone 9, POL Area B; and
8. Zone 10, Shell Bank Fire Training Area.

Criteria for recommending additional analyses for these zones are listed below.

1. Results reported for one or more screening or specific parameters at one or more sampling locations within the zone are sufficiently high to indicte that significant contamination may exist within the zone; and
2. Existing information, particularly the Phase IIb records search, indicates that the contaminants of concern may have been disposed of or spilled within the zone; and
3. Available data for the zone are insufficient to proceed to Alternative 3, mitigative action.

Recommendations for additional monitoring in the zones listed above are given in Section 6.0.

Two alternatives were considered for the remaining two zones; Alternative 2, additional monitoring and Alternative 3, no further action. These zones are:

1. Zone 3, POL Area A; and
2. Zone 4, AAFES Service Station.

The three criteria listed previously were used to decide whether these zones were recommended for additional analyses or for no further action.

Zone 3, POL Area A, was considered for additional monitoring based solely on the results of TOX screening analyses. As discussed in Section 4.3.1, it is suspected that these analyses were subject to positive interferences and may be erroneous. There is no indication in the Phase I

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

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## 6.1 CONCLUSIONS

Most evidence of groundwater contamination at Tyndall AFB is based on general screening analyses. As discussed earlier, these analyses have the advantage of relatively low cost, but they do not identify specific compounds. Analyses for phenolics and DOC measure classes of compounds, portions of which are synthetic organic compounds and portions of which are the result of the natural decay of organic matter. TOX is a measure of total organic halogens which are mostly synthetic. As discussed in Section 4.3.1, the TOX data suggest a positive interference most likely caused by inorganic halides.

A conservative attitude in matters of environmental safety requires that positive results be investigated via expanded sets of analyses. Since the suspected positive TOX interference can be neither verified nor quantified, this assumption also holds for TOX data. An exception to this approach to TOX is taken in cases where the Phase I records search and all other available information indicate that there were no significant quantities of halogenated organic compounds used, spilled, or disposed of within the zone. This exception applies to Zones 2, 3, and 9; all of which are fuel storage areas.

Indications of organic contamination in groundwater require analyses for purgeable organics, base/neutral extractable organic compounds, and acid extractable organic compounds which are three groups of the EPA Priority Pollutant List (Table 13). Approximately one third of the base-neutral extractable organics are halogenated and in theory should be detected by the TOX analysis. Acid extractable organics are all phenolic compounds or cresols. Analyses for TOX and phenolics are included as optional parameters for a mass-balance comparison with halogenated organics (purgeable and chlorinated base-neutral extractables) and acid extractable organics, respectively. Such a mass balance will provide useful information regarding applicability of TOX and total phenolics as screening parameters in IRP studies and will allow more accurate

Table 13. EPA List of 129 Priority Pollutants and the Relative Frequency of these Materials in Industrial Wastewaters† (Page 1 of 4)

| Percent of Samples* | Number of Industrial Categories** | Parameter |
|---|---|---|
| **31 are purgeable organics** | | |
| 1.2 | 5 | Acrolein |
| 2.7 | 10 | Acrylonitrile |
| 29.1 | 25 | Benzene |
| 29.3 | 28 | Toluene |
| 16.7 | 24 | Ethylbenzene |
| 7.7 | 14 | Carbon tetrachloride |
| 5.0 | 10 | Chlorobenzene |
| 6.5 | 16 | 1,2-Dichloroethane |
| 10.2 | 25 | 1,1,1-Trichloroethane |
| 1.4 | 8 | 1,1-Dichloroethane |
| 7.7 | 17 | 1,1-Dichloroethylene |
| 1.9 | 12 | 1,1,2-Trichloroethane |
| 4.2 | 13 | 1,1,2,2-Tetrachloroethane |
| 0.4 | 2 | Chloroethane |
| 1.5 | 1 | 2-Chloroethyl vinyl ether |
| 40.2 | 26 | Chloroform |
| 2.1 | 5 | 1,2-Dichloropropane |
| 1.0 | 5 | 1,3-Dichloropropene |
| 34.2 | 25 | Methylene chloride |
| 1.9 | 6 | Methyl chloride |
| 0.1 | 1 | Methyl bromide |
| 1.9 | 12 | Bromoform |
| 4.3 | 17 | Dichlorobromomethane |
| 6.8 | 11 | Trichlorofluoromethane |
| 0.3 | 4 | Dichlorodifluoromethane |
| 2.5 | 15 | Chlorodibromomethane |
| 10.2 | 19 | Tetrachloroethylene |
| 10.5 | 21 | Trichloroethylene |
| 0.2 | 2 | Vinyl chloride |
| 7.7 | 18 | 1,2-trans-Dichloroethylene |
| 0.1 | 2 | bis (Chloromethyl) ether |
| **46 are base/neutral extractable organic compounds** | | |
| | | 1,2-Dichlorobenzene |
| 6.0 | 9 | 1,3-Dichlorobenzene |
| | | 1,4-Dichlorobenzene |
| 0.5 | 5 | Hexachloroethane |
| 0.2 | 1 | Hexachlorobutadiene |

Table 13. EPA List of 129 Priority Pollutants and the Relative Frequency of these Materials in Industrial Wastewaters† (Page 2 of 4)

| Percent of Samples* | Number of Industrial Categories** | Parameter |
|---|---|---|
| 1.1 | 7 | Hexachlorobenzene |
| 1.0 | 6 | 1,2,4-Trichlorobenzene |
| 0.4 | 3 | bis (2-Chloroethoxy) methane |
| 10.6 | 18 | Naphthalene |
| 0.9 | 9 | 2-Chloronaphthalene |
| 1.5 | 13 | Isophorone |
| 1.8 | 9 | Nitrobenzene |
| 1.1 | 3 | 2,4-Dinitrotoluene |
| 1.5 | 9 | 2,6-Dinitrotoluene |
| 0.04 | 1 | 4-Bromophenyl phenyl ether |
| 41.9 | 29 | bis (2-Ethylhexyl) phthalate |
| 6.4 | 12 | Di-n-octyl phthalate |
| 5.8 | 15 | Dimethyl phthalate |
| 7.6 | 20 | Diethyl phthalate |
| 18.9 | 23 | Di-n-butyl phthalate |
| 5.7 | 11 | Fluorene |
| 7.2 | 12 | Fluoranthene |
| 5.1 | 9 | Chrysene |
| 7.8 | 14 | Pyrene |
| 10.6 | 16 | Phenanthrene |
| | | Anthracene |
| 2.3 | 6 | Benzo(a)anthracene |
| 1.6 | 6 | Benzo(b)fluoranthene |
| 1.8 | 6 | Benzo(k)fluoranthene |
| 3.2 | 8 | Benzo(a)pyrene |
| 0.8 | 4 | Indeno(1,2,3-c,d)pyrene |
| 0.2 | 4 | Dibenzo(a,h)anthracene |
| 0.6 | 7 | Benzo(g,h,i)perylene |
| 0.1 | 2 | 4-Chlorophenyl phenyl ether |
| 0 | 0 | 3,3'-Dichlorobenzidine |
| 0.2 | 4 | Benzidine |
| 1.1 | 4 | bis(2-Chloroethyl) ether |
| 0.8 | 7 | 1,2-Diphenylhydrazine |
| 0.1 | 1 | Hexachlorocyclopentadiene |
| 1.2 | 5 | N-Nitrosodiphenylamine |
| 4.5 | 12 | Acenaphthylene |
| 4.2 | 14 | Acenaphthene |
| 8.5 | 13 | Butyl benzyl phthalate |

Table 13. EPA List of 129 Priority Pollutants and the Relative Frequency of these Materials in Industrial Wastewaters†
(Page 3 of 4)

| Percent of Samples* | Number of Industrial Categories** | Parameter |
|---|---|---|
| 0.1 | 1 | N-Nitrosodimethylamine |
| 0.1 | 2 | N-Nitrosodi-n-propylamine |
| 1.4 | 6 | bis(2-Chloroisopropyl) ether |
| 11 are acid extractable organic compounds | | |
| 26.1 | 25 | Phenol |
| 2.3 | 11 | 2-Nitrophenol |
| 2.2 | 9 | 4-Nitrophenol |
| 1.6 | 6 | 2,4-Dinitrophenol |
| 1.1 | 6 | 4,6-Dinitro-o-cresol |
| 6.9 | 18 | Pentachlorophenol |
| 1.9 | 8 | p-Chloro-m-cresol |
| 2.3 | 10 | 2-Chlorophenol |
| 3.3 | 12 | 2,4-Dichlorophenol |
| 4.6 | 12 | 2,4,6-Trichlorophenol |
| 5.2 | 15 | 2,4-Dimethylphenol |
| 26 are pesticides/PCBs | | |
| 0.3 | 3 | -Endosulfan |
| 0.4 | 4 | -Endosulfan |
| 0.2 | 2 | Endosulfan sulfate |
| 0.6 | 4 | -BHC |
| 0.8 | 6 | -BHC |
| 0.2 | 4 | -BHC |
| 0.5 | 3 | -BHC |
| 0.5 | 5 | Aldrin |
| 0.1 | 3 | Dieldrin |
| 0.04 | 1 | 4,4'-DDE |
| 0.1 | 2 | 4,4'-DDD |
| 0.2 | 2 | 4,4'-DDT |
| 0.2 | 3 | Endrin |
| 0.2 | 2 | Endrin aldehyde |
| 0.3 | 3 | Heptachlor |
| 0.1 | 1 | Heptachlor epoxide |
| 0.2 | 4 | Chlordane |
| 0.2 | 2 | Toxaphene |
| 0.6 | 2 | Arochlor 1016 |

Table 13. EPA List of 129 Priority Pollutants and the Relative Frequency of these Materials in Industrial Wastewaters† (Page 4 of 4)

| Percent of Samples* | Number of Industrial Categories** | Parameter |
|---|---|---|
| 0.5 | 1 | Aroclor 1221 |
| 0.9 | 2 | Aroclor 1232 |
| 0.8 | 3 | Aroclor 1242 |
| 0.6 | 2 | Aroclor 1248 |
| 0.6 | 3 | Aroclor 1254 |
| 0.5 | 1 | Aroclor 1260 |
| --- | -- | 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) |
| 13 are metals | | |
| 18.1 | 20 | Antimony |
| 19.9 | 19 | Arsenic |
| 14.1 | 18 | Beryllium |
| 30.7 | 25 | Cadmium |
| 53.7 | 28 | Chromium |
| 55.5 | 28 | Copper |
| 43.8 | 27 | Lead |
| 16.5 | 20 | Mercury |
| 34.7 | 27 | Nickel |
| 18.9 | 21 | Selenium |
| 22.9 | 25 | Silver |
| 19.2 | 19 | Thallium |
| 54.6 | 28 | Zinc |
| Miscellaneous | | |
| 33.4 | 19 | Total cyanides |
| Not available | | Asbestos (fibrous) |
| Not available | | Total phenols |

†NRDC Consent Agreement and Committee Print 95-30. 1977. Data Relating to H.R. 3199 (Clean Water Act of 1977). Committee on Public Works and Transportation, 95th Congress, 1st Session. Government Printing Office.

*The percent of samples represents the number of times this compound was found in all samples in which it was analyzed for divided by the total as of 31 August 1978. Numbers of samples ranged from 2,532 to 2,998 with the average being 2,617.

**A total of 32 industrial categories and subcategories were analyzed for organics and 28 for metals as of 31 August 1978.

interpretation of Phase IIb data. The expanded set of analyses for organics need not include pesticides or polychlorinated biphenyls (PCBs) since analyses in this study detected insignificant quantities of pesticides (DDT) and the Phase I records search gave no indication of PCB or other pesticide contamination on the base.

Field measurement of pH and specific conductance for all water samples is included with recommended analyses since these are generally performed at no additional cost and can provide useful information.

## 6.2 RECOMMENDATIONS

This section presents recommendations for Phase IIc work at Tyndall AFB on a site-by-site basis. It is recommended that Zones 6 and 7 be given highest priority for Phase IIc work because of their location upgradient of potable water wells at the alert facility and ammunition storage area. Zone 1 should also be given high priority due to high levels of TOX reported there and the relatively steep hydraulic gradient to the adjacent Gulf of Mexico.

One or both of the following criteria were used in selection of Phase IIc sampling locations for specific zones:

1. Phase IIb sampling locations which indicated the greatest potential for contamination were recommended for further analyses.
2. Where multiple wells yielded similar results for screening analyses, a subgroup comprising at least half the total number of wells was recommended for sampling. These wells were selected to maximize areal distribution.

### 6.2.1 Zone 1, Main Base Landfills

Analyze groundwater and surface water for purgeable organics, base/neutral extractable organics, and acid extractable organics to determine if disposal of solvents, strippers, or other wastes within the zone has resulted in contamination of groundwater by organic compounds.

Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available. Well Nos. T1-1 and T1-3 and surface water location T1-5W3 showed the strongest indications of contamination and should be sampled. Well Nos. T1-5 and T1-6 should also be sampled to provide adequate areal coverage for the zone.

#### 6.2.2 Zone 2, Lynn Haven DFSP

Analyze groundwater samples from well Nos. LH2-1 and LH2-2 for DOC, VOA, and oil and grease to determine if disposal of Bunker C fuel west of the facility has resulted in contamination of shallow groundwater by fuels. Measure pH and specific conductance of water samples in the field.

#### 6.2.3 Zone 5, Small Arms Repair Area

Analyze groundwater for purgeable organics, base/neutral extractable organics, and acid extractable organics to determine if disposal of solvents, strippers, or other wastes within the zone has resulted in contamination of groundwater by organic compounds. Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available. Sampling of downgradient well Nos. T5-2 and T5-3 will provide adequate coverage for the zone.

#### 6.2.4 Zone 6, Highway 98 Fire Training Area

Install two additional monitoring wells east of the southeast end of the 150-foot wide runway. Screen one throughout the upper 10 to 15 feet of the water table and the other throughout the 20- to 30-foot depth increment. Analyze groundwater for purgeable organics, base/neutral extractable organics, acid extractable organics, oil and grease [infrared (IR) method], and DOC to characterize groundwater contamination resulting from the use of oils, fuels, and solvent-contaminated POL in fire training exercises. Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available. Recommended sampling

locations are all existing Zone 6 wells (Nos. T6-1, T6-2, and T6-3) and the newly-installed wells between Zone 6 and potable water well No. 11 at the alert facility. Remove all drums from wooded area southwest of site, sample contents, and dispose of drums and contents in acceptable manner according to sampling results.

### 6.2.5 Zone 7, Southeast Runway Extension Burial Site

Analyze groundwater for purgeable organics, base/neutral extractable organics, and acid-extractable organics to determine if disposal of solvents, strippers, or other wastes within the zone has resulted in contamination of groundwater by organic compounds. Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available. Sampling of downgradient monitoring well Nos. T7-2 and T7-3 and potable well No. 11 will provide adequate coverage for the zone. Analyze sample from potable well No. 11 for TDS in addition to above analyses.

### 6.2.6 Zone 8, "6000" Area Landfill

Analyze groundwater for purgeable organics, base/neutral extractable organics, and acid-extractable organics to determine if disposal of solvents, strippers, or other wastes within the zone has resulted in contamination of groundwater by organic compounds. Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available. The recommended sampling location is well No. T8-1, which showed the strongest indications of contamination in the Phase IIb survey.

### 6.2.7 Zone 9, POL Area "B"

Analyze groundwater for DOC, VOA, and oil and grease to determine if groundwater in the vicinity of the fuel tanks has become contaminated with fuels. The recommended sampling location is well No. T9-1, which showed the strongest indications of contamination in the Phase IIb survey.

### 6.2.8 Zone 10, Shell Bank Fire Training Area

Install two monitoring wells between the zone and adjacent water of Shoal Point Bayou. Wells should be screened from at least 2 feet above the water table to a minimum of 5 feet below it. Analyze samples from the two wells for purgeable organics, base/neutral extractable organics, and acid extractable organics to determine if use of solvent-contaminated fuels in fire training exercises has resulted in contamination of groundwater by organic compounds. Measure pH and specific conductance of water samples in the field. The option to analyze for TOX and total phenolics should be considered if adequate resources are available.

# 7.0 REFERENCES

## 7.0 REFERENCES


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APPENDICES

# APPENDIX A

## LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT

## LIST OF ACRONYMS

| | |
|---|---|
| AFB | Air Force Base |
| ASTM | American Society for Testing Materials |
| AFFFs | Aqueous film forming foams |
| AAFES | Army and Air Force Exchange Service |
| avgas | Aviation gasoline |
| BOD | Biochemical oxygen demand |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| DEQPPM | Defense Environmental Quality Program Policy Memorandum |
| DFSP | Defense fuels supply point |
| DPDO | Defense Property Disposal Office |
| DOD | Department of Defense |
| DDT | Dichloro-diphenyl-trichloro-ethane |
| DOC | Dissolved organic carbon (analysis for total organic carbon on a filtered water sample) |
| FAC | Florida Administrative Code |
| FDER | Florida Department of Environmental Regulation |
| FWQS | Florida Water Quality Standards |
| gpd | Gallons per day |
| gpm | Gallons per minute |
| GC | Gas chromatograph |
| GWCI | Groundwater contamination indicators |
| HARM | Hazardous assessment rating methodology |
| ICP | Inductively Coupled Plasma Spectrometry |
| IR | Infrared |
| IRP | Installation Restoration Program |
| JP | Jet petroleum |
| MCL | Maximum contaminant level |
| msl | Mean sea level |
| ug Cl/l | Micrograms chloride per liter |
| ug/kg | Micrograms per kilogram |
| ug/l | Micrograms per liter |
| umho/cm | Micro mho per centimeter |
| mg/kg | Milligrams per kilogram |
| mg/l | Milligrams per liter |
| NIOSH | National Institute for Occupational Safety and Health |
| NPDES | National Pollutant Discharge Elimination System |
| OEHL | Occupational and Environmental Health Laboratory |
| OSHA | Occupational Safety and Health Administration |
| PCP | Pentachlorophenol |
| POL | Petroleum, oil, and lubricants |
| PCB | Polychlorinated biphenyl |
| PVC | Polyvinyl chloride |
| QA/QC | Quality assurance/quality control |
| RCRA | Resource Conservation and Recovery Act |
| TAC | Tactical Air Command |
| TSI | Technical Services, Inc. |
| TDS | Total dissolved solids |
| TOC | Total organic carbon |
| TOX | Total organic halogens |
| TCE | Trichloroethane |
| THM | Trihalomethanes |
| UBTL | Utah Biomedical Testing Lab |
| USAF | United States Air Force |
| EPA | U.S. Environmental Protection Agency |
| VOA | Volatile aromatics |
| VOH | Volatile halocarbons |
| WAR | Water and Air Research, Inc. |

**APPENDIX B**

**SCOPE OF WORK FOR IRP PHASE IIB
FIELD EVALUATION, TYNDALL AFB, FLORIDA**

# APPENDIX B

## Scope of Work for IRP Phase IIB Field Evaluation
## Tyndall AFB, Florida

I. Description of Work:

The purpose of this task is to determine if environmental contamination has resulted from waste disposal practices at Tyndall AFB, Florida; to provide estimates of the magnitude and extent of contamination, should contamination be found; to identify potential environmental consequences of migrating pollutants; to identify any additional investigations and their attendant costs necessary to properly evaluate the magnitude, extent, and direction of movement of discovered contaminants.

The presurvey report and Phase I IRP report incorporated background and description of the sites for this task. To accomplish the survey effort, the contractor shall take the following steps:

A. General

1. Locations where surface water samples are collected shall be marked with a permanent marker, and the location recorded on a project map for the zone.
2. All water samples collected shall be analyzed on-site by the contractor for pH, temperature, and specific conductance. Sampling, maximum holding time and preservation of samples shall strictly comply with the following references: <u>Examination of Water and Wastewater</u>, 15th Ed. (1980), pp. 35-42; <u>ASTM</u>, Part 31, pp. 72-82, (1976), Method D-3370; and <u>Methods for Chemical Analysis of Waters and Wastes</u>, EPA Manual/600/4-79-020, pp. xiii to xix (1979). The contractor shall comply with the detection limits for chemical compounds enumerated in Attachment 1. Mass spectrometric confirmation should only be used on samples that contain an inordinate number of interferences.

Table B-1. Required Sample Detection Limits

| Chemical | Concentration | |
|---|---|---|
| | Water | Soil |
| Total organic carbon (TOC) | 1 mg/l | |
| Total organic halogen (TOX) | 5 ug/l | |
| Phenols | 1 ug/l | 1.0 ug/g |
| Iron | 100 ug/l | |
| Zinc | 50 ug/l | 0.5 ug/g |
| Lead | 20 ug/l | 0.2 ug/g |
| Nickel | 100 ug/l | 1.0 ug/g |
| Cadmium | 10 ug/l | 0.1 ug/g |
| DDT and Isomers | | 0.02 ug/g |
| Oils and greases (IR Method) | 0.1 mg/l | |
| Volatile aromatics | * | |
| Volatile halocarbons | * | |

*Detection limits for volatile halocarbons and volatile aromatics shall be the same as specified for the compounds in EPA Methods 601 and 602.

3. All contractor installed wells shall be developed, water levels measured, and locations surveyed and recorded on project map and on a specific zone map. Wells shall be of sufficient depth to collect samples representative of aquifer quality and to intercept contaminants if they are present in the surface aquifer.
4. Field data collected for each zone shall be plotted and mapped. The nature, magnitude, and potential for contaminant flow within each zone to receiving streams and groundwaters shall be estimated. Upon completion of the sampling and analysis, the data shall be tabulated in the next R&D Status report as specified in Item VI below.

B. In addition to items delineated in A above, conduct the following specific actions at sites identified on Tyndall AFB:

1. Zone 1. Site 6 and Site 7 (Main Base Landfills)
    a. Install six shallow groundwater monitoring wells. Collect one groundwater sample from each installed well.
    b. Collect surface water samples from a maximum of four locations adjacent to the landfills.
    c. Collect sediment samples from a maximum of three locations within the zone.
    d. Collect one groundwater sample from the well located adjacent to the spray irrigation field.
    e. Analyze each well water and surface water sample as follows: total organic carbon (TOC), total organic halogen (TOX), phenol, iron, zinc, chromium (total), lead, nickel, and cadmium.
    f. Sediment samples shall be analyzed for iron, zinc, chromium (total), lead, nickel, cadmium, total organic halogen, and DDT and its metabolites.
2. Zone 2. Lynn Haven DFSP
    a. Install seven shallow groundwater monitoring wells within the zone.
    b. Collect one groundwater sample from each well installed. Samples shall be collected within 2 hours of high tide.

c. Analyze each groundwater sample collected for total organic carbon, lead, oils and grease by EPA Method 413.2 and total organic halogen.

d. Measure the quantity of fuel floating on the surface of the aquifer at each monitoring location. This effort shall include collection of a groundwater sample using a transparent bailer and estimating the quantity of fuel floating atop the water column.

3. Zone 3. Site 14 (POL Area)

   a. Install four auger holes approximately 8 feet deep.

   b. Collect a sample of accumulated water in each hole and analyze each sample for total organic carbon (TOC), oil and grease by EPA Method 413.2, total organic halogen (TOX) and lead.

   c. Collect a single water sample from the potable water well located within the zone. Analyze the potable water sample for volatile aromatic and volatile halocarbon compounds using GC techniques.

4. Zone 4. AFEES Service Station

   a. Install one groundwater monitoring well downgradient of the leaking tank.

   b. Collect one sample from the well and determine if petroleum products are present. A transparent bailer shall be used to observe and quantify the thickness of any petroleum product layer on the groundwater surface.

5. Zone 5. Site B. Small Arms Repair Area

   a. Install three hand augered wells within the zone.

   b. Collect one water sample from each well.

   c. Analyze each sample for total organic carbon (TOC), total organic halogen (TOX), lead, and chromium.

6. Zone 6. Site D. Drum Disposal Area

   a. Install three shallow groundwater monitoring wells.

   b. Collect one groundwater sample from each installed well.

   c. Analyze each water sample for total organic carbon (TOC), phenol, lead, and using GC techniques, volatile aromatics and volatile halocarbons.

7. Zone 7. Site 4. SE Runway Extension Area

   a. Install three shallow groundwater monitoring wells within the zone.

   b. Collect one groundwater sample from each well.

   c. Collect one groundwater sample from the existing well at the alert facility east of the fill.

   d. Analyze each water sample for total organic carbon (TOC), phenol, lead, and using GC techniques, volatile aromatics, and volatile halocarbons.

8. Zone 8. Site 5. 6000 Area Landfill

   a. Install two groundwater monitoring wells in this zone.

   b. Collect one groundwater sample from each well.

   c. Analyze each groundwater sample collected for total organic carbon (TOC), total organic halogen (TOX), phenol, lead, zinc, and chromium.

9. Zone 9. Site 15. POL Area B

   a. Install two groundwater monitoring wells in this zone.

   b. Collect one groundwater sample from each well.

   c. Analyze each groundwater sample collected for total organic carbon (TOC), total organic halogen (TOX), and lead.

10. Zone 10. Site 16. Shell Bank Fire Training Area

   a. Install four pit wells within the zone.

   b. Collect one groundwater sample from each well.

   c. Analyze each groundwater sample for total organic carbon (TOC), total organic halogen (TOX), phenol, and lead.

C. Well Installation and Cleanup

Well installations shall be cleaned following the completion of the well. Drill cuttings will be removed and the general area cleaned.

D. Data Review

Results of sampling and analysis shall be tabulated and incorporated in the monthly R&D Status Reports and forwarded to the USAF OEHL for review as soon as they become available as specified in Item VI below.

E. Report Preparation

1. A report delineating all findings of this field investigation shall be prepared and forwarded to the USAF OEHL as specified in Item VI below for Air Force review and comment. This report shall include a discussion of the regional hydrogeology, well logs of all project wells, data from water level surveys, water quality analysis results, available geohydrologic cross sections, groundwater surface and gradient vector maps, vertical and horizontal flow vectors, and laboratory quality assurance information. The report shall follow the USAF OEHL supplied format (mailed under separate cover).
2. Estimates shall be made of the magnitude, extent, and direction of movement of contaminants discovered. Potential environmental consequences of discovered contamination must be identified. Where survey data are insufficient to properly evaluate the magnitude, extent, and direction of movement of discovered contaminants, specific recommendations, fully justified, shall be made for additional efforts required to properly evaluate contamination migration.
3. Specific requirements for future groundwater and surface water monitoring must be identified.

F. Quality Assurance

The quality assurance specified in Section H, para (xxi) of the contract is applicable to this order.

G. Cost Estimates

Detailed cost estimates for all additional work recommended for those sites in need of proper determination or estimate of the magnitude, extent, and direction of movement of discovered contaminants shall be provided, along with an estimate of the time required to accomplish the proposed effort. This information shall be included in a separately bound appendix to the draft final report.

II. Site Location and Dates: Tyndall AFB, Florida
USAF Hospital/SGPM
Dates to be established

III. Base Support: None

IV. Government Furnished Property: None

V. Government Points of Contact:

1. Major Gary Fishburn
USAF OEHL/EC
Brooks AFB, TX 78235
(512) 536-3305
AV 240-3305

2. Col. Jerry Dougherty
HQ TAC/SGPAE
Langley AFB, VA 23665
(804) 764-2180
AV 787-6210 AV 432-2180

3. 2Lt. Dan Morton
USAF Hospital Tyndall
(904) 283-4474
AV 970-4474

VI. In addition to sequence numbers 1, 5, and 11 listed in Attachment 1 to the contract, which are applicable to all orders, the reference numbers below are applicable to this order. Also shown are data applicable to this order.

| Sequence No. | Block 10 | Block 11 | Block 12 | Block 13 | Block 14 |
|---|---|---|---|---|---|
| 4* | ONE/R | 84FEB17 | 84MAR02 | 84JUN02 | * |

*Contractor shall supply the USAF OEHL with 15 copies of the draft report and 50 copies plus the original, camera ready copy of the final report.

# APPENDIX C

# MONITORING WELL COMPLETION LOGS

SHEET 1 OF 1

Boring No. T1-1

Location Coordinates N 385,066 E 1,657,358

Hole Size 15.2 FT. × 6 IN Slot 0.010 IN.

Screen Size 9 FT. × 2 IN. Mat'l SCH 40 PVC

Filter Materials NATIVE SAND

Casing Size 15.2 FT. × 2 IN Mat'l SCH 40 PVC

Grout Type SAND CEMENT

Geologist W. THIESS

Protective Casing 5 FT × 6 IN IRON

Date Start 11/10/83 Finish 11/11/83

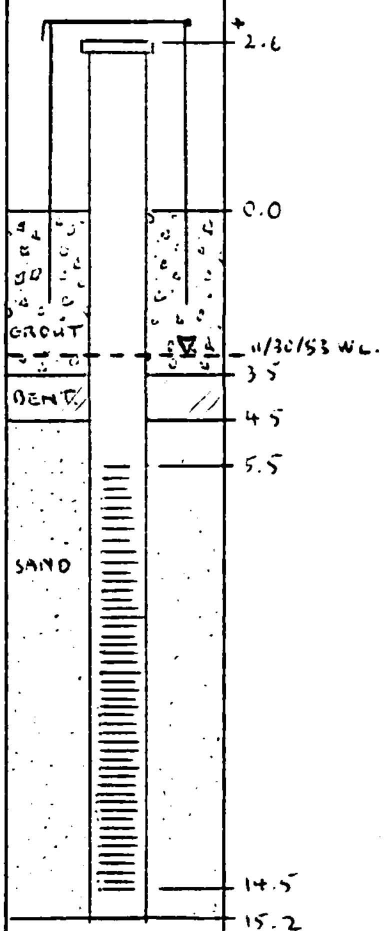
Static Water Level 3.4 FT. MSL (11/30/83)

Contractor WAR / WTD

Top of Well Elevation 10.2 FT MSL

Driller P. WRIGHT

Drill Type 6-INCH HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, GRAY-BROWN (10YR 4/2) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, WET, WHITE | SP-SW | 2+7 |
| | | 10-11.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE | SP-SW | 1+1 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (10YR 5/2) | SP-SW | 5+0 |

SHEET 1 OF 1

Boring No. T1-2

Hole Size 15.2 FT. x 6 IN. Slot 0.010 IN.

Screen Size 9 FT. x 2 IN. Mat'l SCH 40 PVC

Casing Size 15.2 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/10/83 Finish 11/11/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 384,924

E 1,657,508

Filter Materials NATIVE SAND

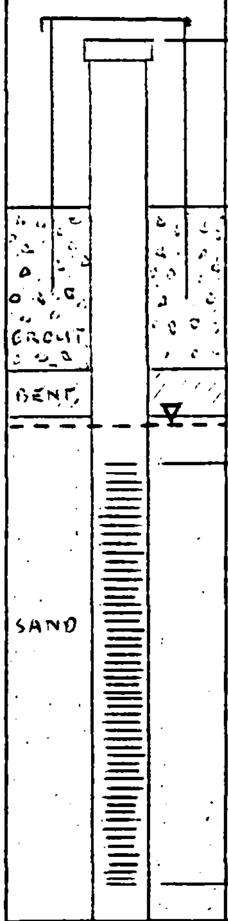
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 3.3 FT MSL (11/30/83)

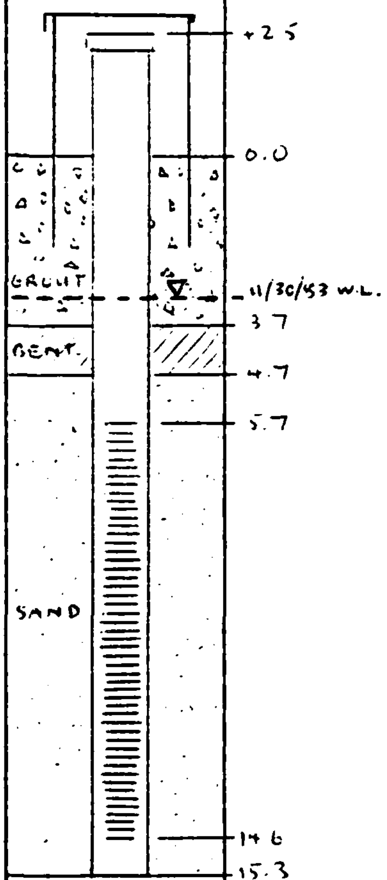
Top of Well Elevation 11.5 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | +2.7 | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG. TR. SILT + CLAY, TR. ORGANICS, DRY, GRAY-BROWN (10YR 5/2) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., MOIST, WHITE | SP-SW | 17+17 |
| | 0.0 | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE | SP-SW | 4+3 |
| | 3.5<br>4.5<br>11/30/83 W.L.<br>5.5<br>14.5<br>15.2 | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/2) | SP-SW | 1+0 |

SHEET 1 OF 1

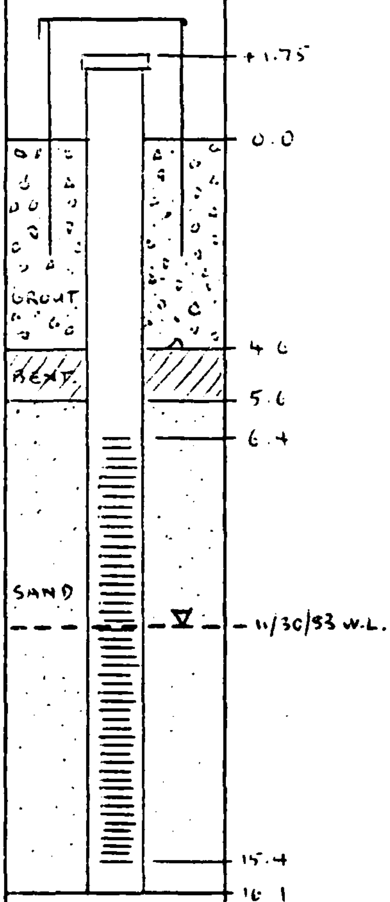
| | |
|---|---|
| Boring No. T1-3 | Location Coordinates N 354,715 |
| Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN | E 1,657,811 |
| Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC | Filter Materials NATIVE SAND |
| Casing Size 15.3 FT. x 2 IN. Mat'l SCH. 40 PVC | Grout Type SAND CEMENT |
| Geologist W THIESS | Protective Casing 5 FT. x 6 IN. IRON |
| Date Start 11/10/83 Finish 11/11/83 | Static Water Level 3.0 FT. MSL (11/30/83) |
| Contractor WAR / WTD | Top of Well Elevation 8.6 FT. MSL |
| Driller P WRIGHT | Drill Type 6-IN. HOLLOW STEM AUGER |




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, LT. BROWN (10YR 6/2) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE | SP-SW | 6+12 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (10YR 7/2) | SP-SW | 5+6 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY TR. HVY. MIN., SATURATED, BROWN (10 YR 6/3) | SP-SW | 10+13 |

SHEET 1 OF 1

| | |
|---|---|
| Boring No. T1-4 | Location Coordinates N 385,181 |
| Hole Size 16.1 FT. x 6 IN. Slot 0.010 IN. | E 1,658,628 |
| Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC | Filter Materials NATIVE SAND |
| Casing Size 16.1 FT. x 2 IN. Mat'l SCH. 40 PVC | Grout Type SAND CEMENT |
| Geologist W. THIESS | Protective Casing 5 FT. x 6 IN. IRON |
| Date Start 11/10/83 Finish 11/10/83 | Static Water Level 8.3 FT. MSL (11/30/83) |
| Contractor WAR/WTD | Top of Well Elevation 20.5 FT. MSL |
| Driller P. WRIGHT | Drill Type 6-IN. HOLLOW STEM AUGER |




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. GRAY (10YR 3/1) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, VF, QTZ., SUB ANG., 5% SILT + CLAY, TR. ORGANICS, MOIST, DK. GRAY (10YR 3/1) | SP | 4+5 |
| | | 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., MOIST, LT. BROWN (10YR 7/3) | SP-SW | 4+4 |
| | | 15-16.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE | SP-SW | 6+9 |

records search or elsewhere that significant quantities of chlorinated organic compounds entered the zone. Zone 3 fails the second of the three criteria listed for recommending additional monitoring and as a result is recommended for Alternative 3, no further action.

Additional monitoring was considered for Zone 4, the AAFES Service Station, on the basis that visual observations and measurement of a fuel layer, if present, would incur minimal or no additional cost in a monitoring program. This confirmation was judged to be unnecessary. Alternative 3, no further action, is recommended for Zone 4 because there was no visual evidence of fuel contamination, there are no potable water supplies that could be impacted by fuel contamination, and the relatively large distance (approximately 2,500 feet) to the nearest surface water body minimizes the potential for aquatic impacts from any residual contamination.

SHEET 1 OF 1

Boring No. T1-5

Hole Size 15.2 FT. x 6 IN. Slot 0.010 IN.

Screen Size 9 FT. x 2 IN. Mat'l SCH 40 PVC

Casing Size 15.2 FT. x 2 IN. Mat'l SCH 40 PVC

Geologist W. THIESS

Date Start 11/10/83 Finish 11/10/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 384,638

E 1,658,696

Filter Materials NATIVE SAND

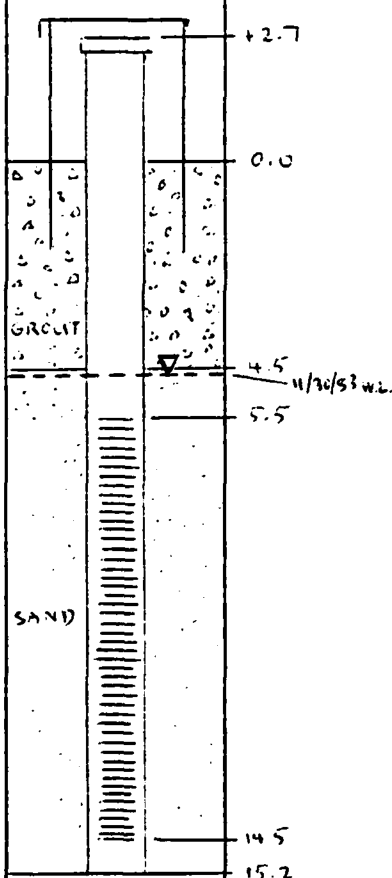
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 6.5 FT. MSL (11/30/83)

Top of Well Elevation 14.0 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. GRAY (10YR 3/1) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY. MIN., WET, LT. BROWN (10YR 6/3) | SP SW | 4+4 |
| | | 10-11.5 FT. | SAND, AS ABOVE, SATURATED | SP-SW | 14+17 |
| | | 15-16.5 FT. | SAND, AS ABOVE | SP-SW | 26+30 |

SHEET 1 OF 1

Boring No. T1-6

Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN.

Screen Size 9 FT. x 2 IN Mat'l SCH. 40 PVC

Casing Size 15.3 FT. x 2 IN Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/10/83 Finish 11/10/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 384,521

E 1,659,492

Filter Materials NATIVE SAND

Grout Type SAND CEMENT

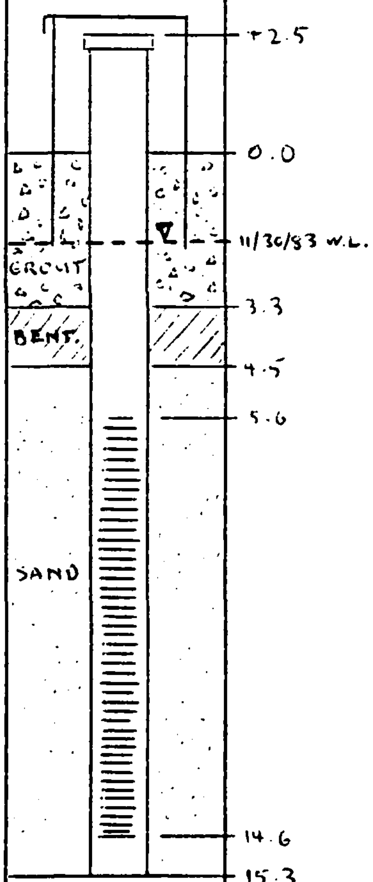
Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 13.7 FT. MSL (11/30/8

Top of Well Elevation 18.1 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, GRAY-BROWN (10YR 4/1) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, WET, LT. GRAY (10YR 7/1) | SP | 4+4 |
| | | 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., TR SILT + CLAY, SATURATED, DK. BROWN (10YR 4/2) | SP-SW | 3+5 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY MIN., SATURATED, WHITE | SP | 10+14 |



SHEET 1 OF 1

Boring No. LH 2-1

Hole Size 13.3 FT x 6 IN. Slot 0.010 IN.

Screen Size 12 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 13.3 FT x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR / WTD

Driller P WRIGHT

Location Coordinates N 455,765

E 1,627,479

Filter Materials NATIVE SAND

Grout Type NA

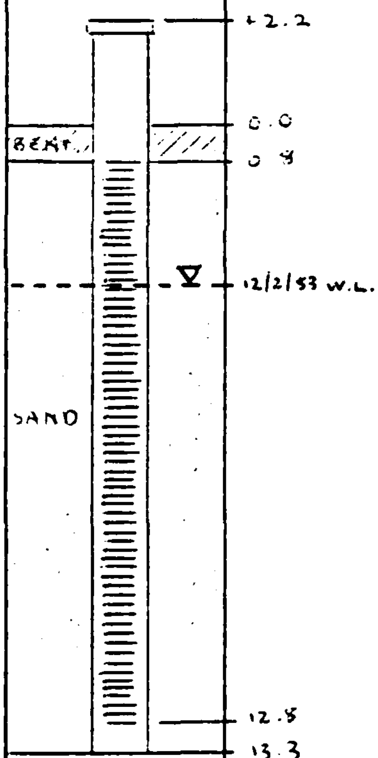
Protective Casing NONE

Static Water Level 4.4 FT. MSL (12/2/83)

Top of Well Elevation 10.1 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, YELLOW (10YR 8/3) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, SATURATED, LT. BROWN (10YR 7/2) | SP-SW | 1+2 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., 5% SILT + CLAY, SATURATED, BROWN (10YR 6/4), TRACE ORGANIC ODOR (FUEL?) | SP | 1+2 |



SHEET 1 OF 1

Boring No. LH 2-2

Hole Size 13.3 FT. x 6 IN. Slot 0.010 IN.

Screen Size 12 FT. x 2 IN. Mat'l SCH 40 PVC

Casing Size 13.3 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 456,030

E 1,629,600

Filter Materials NATIVE SAND

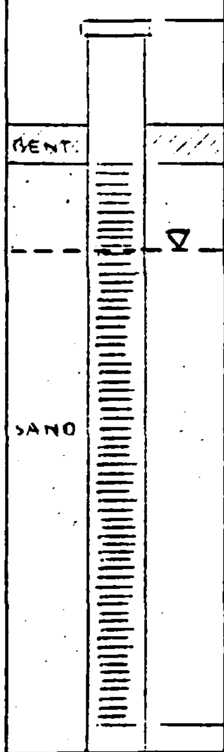
Grout Type NA

Protective Casing NONE

Static Water Level 1.9 FT. MSL /12/2/83

Top of Well Elevation 6.5 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | +2.2<br>0.0<br>0.8<br>12/2/83 W.L.<br>12.8<br>13.3 | 0-1.5 FT. | SAND, F-M, QTZ., SUB ANG, TR. SILT + CLAY, TR. HVY MIN., MOIST, PALE YELLOW (10YR 8/2) | SP | NA |
| | | 5-6.5 FT. | SAND, M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (10YR 7/2) | SP | 1+1 |
| | | 10-11.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND, 10% SILT + CLAY, SATURATED, LT. GRAY (10YR 7/1), SLIGHT FUEL ODOR | SP-SW | 5+6 |

Boring No. LH2-3

Hole Size 13.3 FT. × 6 IN. Slot 0.010 IN.

Screen Size 12 FT. × 2 IN. Mat'l SCH 40 PVC

Casing Size 13.3 FT. × 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 456,024

E 1,630,191

Filter Materials NATIVE SAND

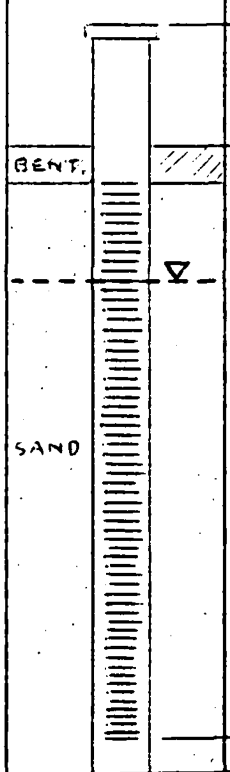
Grout Type NA

Protective Casing NONE

Static Water Level 1.1 FT. MSL (12/2/83)

Top of Well Elevation 6.6 FT. MSL

Drill Type 6-IN HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | +2.7<br>0.0<br>0.9<br>12/2/83 W.L.<br>12.8<br>13.3 | 0-1.5 FT. | SAND, F., QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. BROWN (10YR 4/2), SOME CONSTRUCTION RUBBLE PRESENT IN TOP 1.0 FT. | SP | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, SATURATED, LT. GRAY-BROWN (10YR 6/1) | SP | 14+12 |
| | | 10-11.5 FT. | SAND, VF-M, QTZ., SUB ANG., 30% SILT + CLAY, TR. ORGANICS, SATURATED, SULFUR ODOR, DK. BROWN (10YR 3/2) | SP | 1+1 |

SHEET 1 OF 1

Boring No. LH 2-4

Hole Size 13.3 FT x 6 IN. Slot 0.010 IN

Screen Size 12 FT x 2 IN. Mat'l SCH. 40 PVC

Casing Size 13.3 FT x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 456,019
E 1,630,806

Filter Materials NATIVE SAND

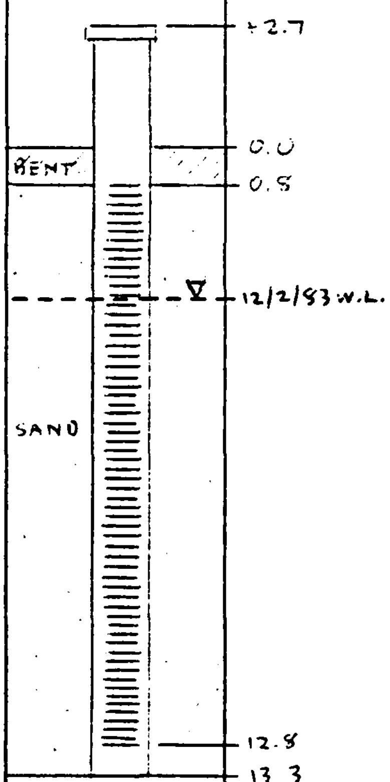
Grout Type NA

Protective Casing NONE

Static Water Level 2.0 FT. MSL (12/2/83)

Top of Well Elevation 7.8 FT MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, BROWN-GRAY MIXTURE (10YR5/2-7.5YR 3/1) | SP | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (10YR 7/2) | SP | 8+10 |
| | | 10-11.5 FT. | SAND, F-M, QTZ., SUB ANG.-SUB RND., 5% SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (10YR 6/2) | SP | 1+1 |

SHEET 1 OF 1

Boring No. LH 2-5

Hole Size 13.3 FT x 6 IN. Slot 0.010 IN.

Screen Size 12 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 13.3 FT x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR / WTD

Driller P WRIGHT

Location Coordinates N 456,CC8
E 1,631,570

Filter Materials NATIVE SAND

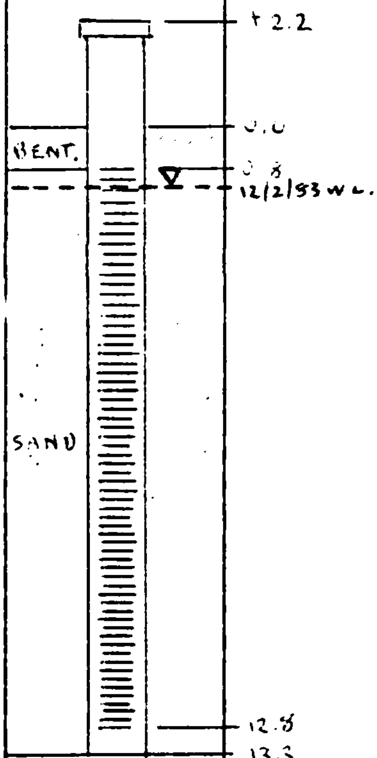
Grout Type NA

Protective Casing NONE

Static Water Level 1.8 FT. MSL (12/2/83)

Top of Well Elevation 7.C FT MSL

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, LT. BROWN (10YR 6/2) | SP | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., WET, WHITE | SP-SW | 6+6 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY MIN., SATURATED, LT. BROWN (10YR 6/2) | SP | 7+9 |

Boring No. LH2-6

Hole Size 13.3 FT. × 6 IN. Slot 0.010 IN

Screen Size 12 FT. × 2 IN. Mat'l SCH. 40 PVC

Casing Size 13.3 FT × 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 455,552
E 1,631,900

Filter Materials NATIVE SAND

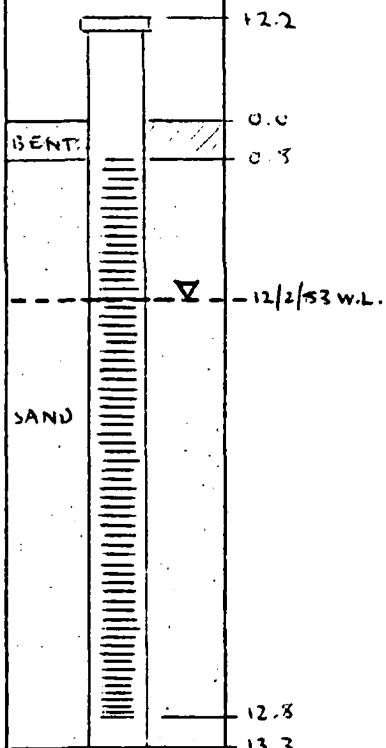
Grout Type NA

Protective Casing NONE

Static Water Level 2.3 FT. MSL (12/2/83)

Top of Well Elevation 8.4 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, LT. BROWN (10YR 6/2) | SP | NA |
| | +2.2 | 5-6.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 7/2) | SP-SW | 5+8 |
| BENT. | 0.0<br>0.3 | 10-11.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND. 10% SILT + CLAY, SATURATED, GRAY-BROWN (10YR 6/2) | SP | 1+2 |
| SAND | 12/2/83 W.L.<br>12.8<br>13.3 | | | | |

SHEET 1 OF 1

Boring No. LH2-7

Hole Size 12 FT x 6 IN. Slot 0.010 IN

Screen Size 11.3 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 12 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/9/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 454,821

E 1,630,885

Filter Materials NATIVE SAND

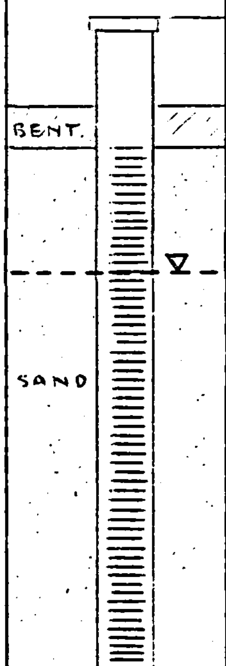
Grout Type NA

Protective Casing NONE

Static Water Level 3.0 FT. MSL (12/2/83)

Top of Well Elevation 8.5 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. BROWN (10YR 3/2) | SP | NA |
| | +1.4 | 5-6.5 FT. | SAND, F, QTZ., SUB ANG, TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 5/2) | SP-SW | 5+9 |
| | 0.0<br>0.8 | 10-11.5 FT. | SAND, AS ABOVE, SLIGHT FUEL ODOR | SP-SW | 5+7 |
| | 12/2/83 W.L. | | | | |
| | 12.0 | | | | |

SHEET 1 OF 1

Boring No. T3-1

Hole Size 10.3 FT x 6 IN. Slot 0.010 IN.

Screen Size 9 FT x 2 IN. Mat'l SCH. 40 PVC

Casing Size 10.3 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/5/83 Finish 11/5/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 378,884

E 1,655,311

Filter Materials NATIVE SAND

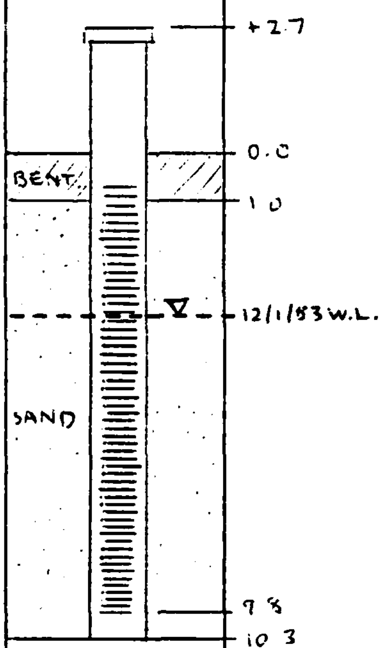
Grout Type NA

Protective Casing NONE

Static Water Level 4.7 FT MSL (12/1/83

Top of Well Elevation 10.9 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR SILT + CLAY, TR. ORGANICS, DRY, WHITE W/ BROWN STREAKS (10YR 6/4) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., WET, YELLOW-BROWN (10YR 7/6) | SP | 3+3 |
| | | 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE W/ GRAY STREAKS (7.5 YR 6/1) | SP | 7+7 |

Boring No. T3-2

Hole Size 10.3 FT. x 6 IN. Slot 0.010 IN

Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 10.3 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/5/83 Finish 11/5/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 399,863

E 1,655,474

Filter Materials NATIVE SAND

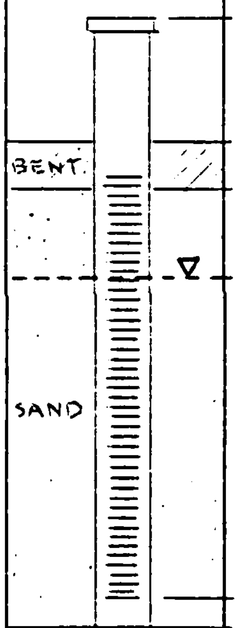
Grout Type NA

Protective Casing NONE

Static Water Level 3.3 FT MSL (12/1/83)

Top of Well Elevation 8.9 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | +2.7<br>0.0<br>1.0<br>12/1/83 W.L.<br>9.8<br>10.3 | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, DRY, LT. BROWN (10YR 7/3) | SP | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, SATURATED | SP | 3+5 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, SATURATED, WHITE | SP-SW | 5+6 |

Boring No. T3-3

Hole Size 9.3 FT. x 6 IN. Slot 0.010 IN

Screen Size 9 FT x 6 IN Mat'l SCH. 40 PVC

Casing Size 9.3 FT. x 6 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/5/83 Finish 11/5/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 398,846

E 1,655,749

Filter Materials NATIVE SAND

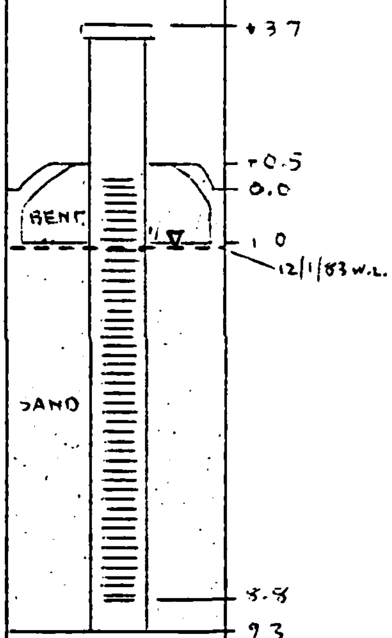
Grout Type NA

Protective Casing NONE

Static Water Level 1.1 FT. MSL (12/1/83)

Top of Well Elevation 5.8 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, MOIST, WHITE W/BROWN STREAKS (10YR 8/1) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., 5% SILT + CLAY, TR. HVY. MIN., SATURATED, GRAY-BROWN (10YR 6/1) | SP-SW | 2+6 |
| | | 10-11.5 FT. | SAND, F-M, SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, SATURATED, WHITE | SP | 5+8 |

Boring No. T3-4

Location Coordinates N 395,124 E 1,655,575

Hole Size 10.3 FT. x 6 IN. Slot 0.010 IN

Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC

Filter Materials NATIVE SAND

Casing Size 10.3 FT. x 6 IN Mat'l SCH. 40 PVC

Grout Type NA

Geologist W. THIESS

Protective Casing NONE

Date Start 11/5/83 Finish 11/5/83

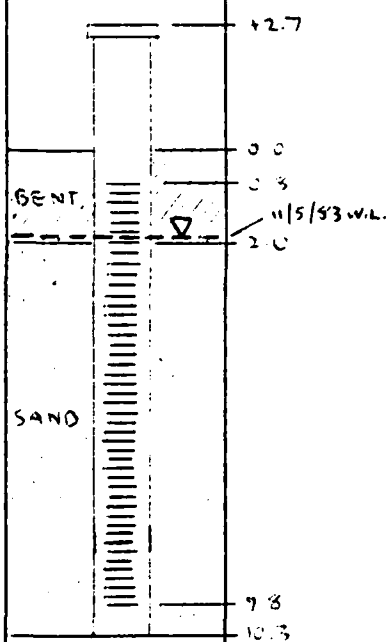
Static Water Level 1.8 FT MSL (11/5/83)

Contractor WAR/WTD

Top of Well Elevation 7.8 FT. MSL

Driller R. WRIGHT

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG. TR. CALCAREOUS SHELL FRAGMENTS, 10% ORGANICS, 5% SILT + CLAY, MOIST, BLACK | SP | NA |
| | | 5-6.5 FT. | SAND, VF-F, QTZ., SUB ANG., 5% CALCAREOUS SHELL FRAGMENTS, 5% SILT + CLAY, 10% ORGANICS, WET, LT. BROWN (10YR 6/3) | SP | 2+5 |
| | | 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG., 5% SILT + CLAY, 5% ORGANICS, SATURATED, GRAY (10YR 5/1) | SP | 3+2 |

SHEET 1 OF 1

Boring No. T4-1

Location Coordinates N 390,163

E 1,653,436

Hole Size 20.1 FT x 6 IN Slot 0.010 IN.

Screen Size 14 FT. x 2 IN. Mat'l SCH. 40 PVC

Filter Materials NATIVE SAND

Casing Size 20.1 FT. x 2 IN Mat'l SCH. 40 PVC

Grout Type SAND CEMENT

Geologist W THIESS

Protective Casing 5 FT x 6 IN IRON

Date Start 11/11/83 Finish 11/11/83

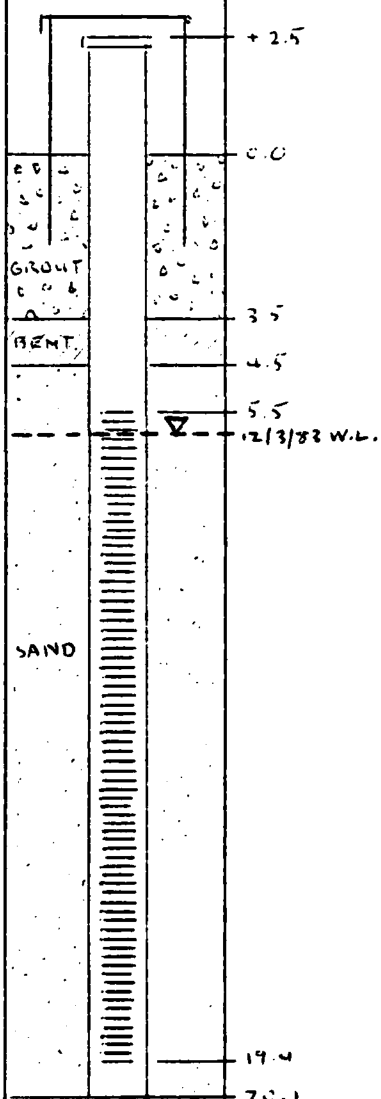
Static Water Level 23.1 FT. MSL (12/3/83)

Contractor WAR/WTD

Top of Well Elevation 31.6 FT MSL

Driller P WRIGHT

Drill Type 6-IN HOLLOW STEM AUGER




| Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|
| 0-1.5 FT. | SAND, VF, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. BROWN (10YR 4/2) | SP | NA |
| 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, MOIST, LT. BROWN (10YR 7/3) | SP-SW | 8+10 |
| 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/2) | SP-SW | 3+6 |
| 15-16.5 FT. | SAND, AS ABOVE | SP-SW | 22+50 |
| 20-21.5 FT. | SAND, VF-F, QTZ., SUB ANG., 5% SILT + CLAY, SATURATED, DK. BROWN (10YR 3/3), OIL SHEEN VISIBLE ON WATER RELEASED FROM SAND, NO DETECTABLE FUEL ODOR | SP-SW | 30+50/4 |

Boring No. T5-1

Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN.

Screen Size 9 FT. x 2 IN Mat'l SCH. 40 PVC

Casing Size 15.3 FT. x 2 IN Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/4/83 Finish 11/10/83

Contractor WAR/WTD

Driller P WRIGHT

Location Coordinates N 345,811
E 1,654,383

Filter Materials NATIVE SAND

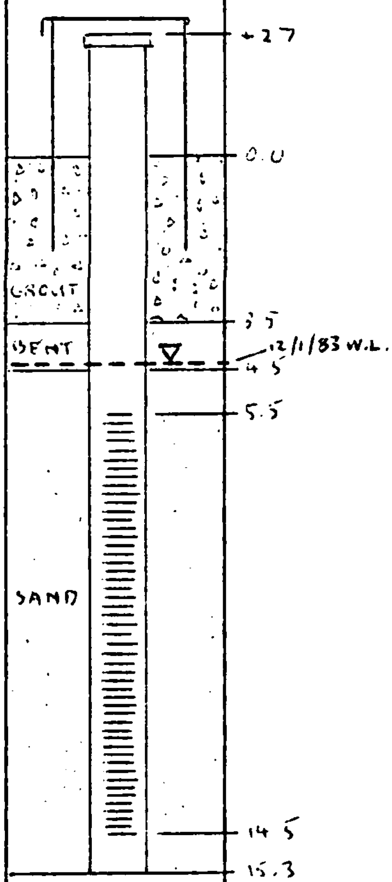
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 6.5 FT. MSL (12/1/83)

Top of Well Elevation 13.6 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

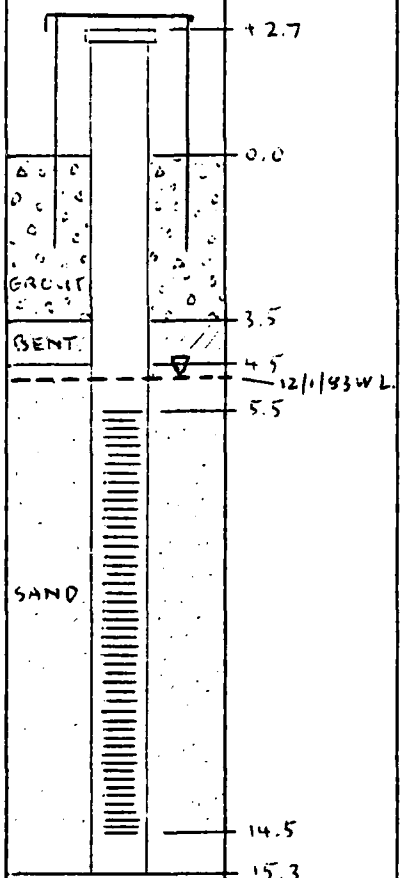



| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F-M, QTZ., SUB ANG., 5% SILT + CLAY, TR. ORGANICS, DRY, LT. BROWN - GRAY MIXTURE (10YR 7/6 - 10YR 5/1) | SP | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG, 5% SILT + CLAY, TR. ORGANICS, MOIST, LT. BROWN (2.5YR 7/6) | SP-SW | 3+4 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/3) | SW | 2+3 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., 15% SILT + CLAY, SATURATED, DK. BROWN (2.5YR 5/2) | SP | 6+8 |

SHEET 1 OF 1

Boring No. T5-2
Hole Size 15.3 FT. × 6 IN Slot 0.010 IN.
Screen Size 9 FT × 2 IN Mat'l SCH. 40 PVC
Casing Size 15.3 FT × 2 IN Mat'l SCH 40 PVC
Geologist W. THIESS
Date Start 11/4/83 Finish 11/10/83
Contractor WAR / WTD
Driller C WRIGHT

Location Coordinates N 378,955
E 1,654,358
Filter Materials NATIVE SAND
Grout Type SAND CEMENT
Protective Casing 5 FT × 6 IN IRON
Static Water Level 5.9 FT. MSL (12/1/83)
Top of Well Elevation 13.4 FT. MSL
Drill Type 6-IN. HOLLOW STEM AUGER

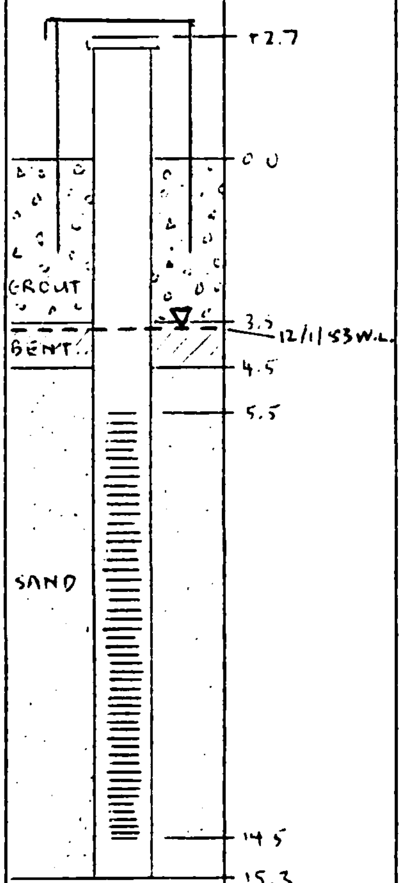



| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, DRY, WHITE - LT GRAY (10YR 7/1) MIXTURE | SW | NA |
| | | 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG., 5% SILT + CLAY, TR. HVY. MIN., MOIST, BROWN (10YR 7/6) W/ GRAY STREAKS (10YR 7/1) | SP-SW | 3+2 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE | SW | 3+4 |
| | | 15-16.5 FT. | SAND, VF-F, QTZ., SUB ANG., 10% SILT + CLAY, TR. HVY. MIN., SATURATED, LT. BROWN (7.5YR 7/2) | SP | 9+10 |

SHEET 1 OF 1

Boring No. T5-3
Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN
Screen Size 9 FT x 2 IN. Mat'l SCH. 40 PVC
Casing Size 15.3 FT. x 2 IN. Mat'l SCH. 40 PVC
Geologist W. THIESS
Date Start 11/4/83 Finish 11/10/83
Contractor WAR / WTD
Driller P. WRIGHT

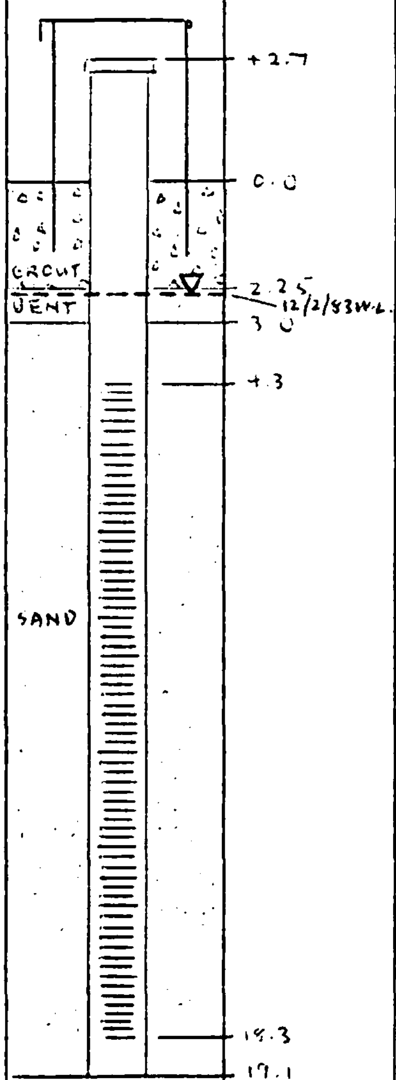
Location Coordinates N 395,937
E 1,654,525
Filter Materials NATIVE SAND
Grout Type SAND CEMENT
Protective Casing 5 FT x 6 IN IRON
Static Water Level 6.1 FT. MSL (12/1/83)
Top of Well Elevation 12.6 FT. MSL
Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, DRY, LT. BROWN (10YR 7/6) W/ GRAY STREAKS | SP-SW | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. HVY. MIN., WET, YELLOW (10YR 8/6) | SW | 4+6 |
| | | 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., 5% SILT + CLAY, TR. HVY MIN., SATURATED, LT. BROWN (10YR 6/3) | SP-SW | 2+3 |
| | | 15-16.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., 5% SILT + CLAY, TR. HVY. MIN., SATURATED, DK. BROWN (7.5YR 5/2) | SP-SW | 11+14 |

SHEET 1 OF 1

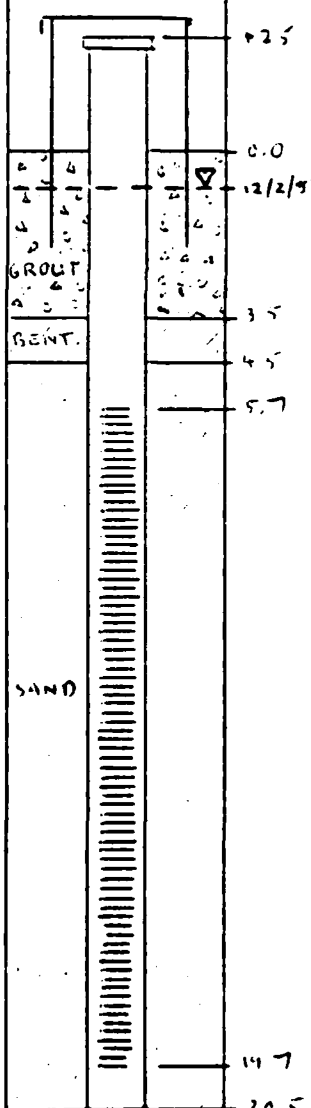
Boring No. T6-1
Hole Size 19.1 FT. x 6 IN Slot 0.010 IN
Screen Size 14 FT. x 2 IN Mat'l SCH-40 PVC
Casing Size 19.1 FT. x 2 IN Mat'l SCH. 40 PVC
Geologist W. THIESS
Date Start 11/8/83 Finish 11/8/83
Contractor WAR/WTD
Driller P. WRIGHT

Location Coordinates N 336,396
E 1,660,116
Filter Materials NATIVE SAND
Grout Type SAND CEMENT
Protective Casing 5 FT. x 6 IN. IRON
Static Water Level 23.9 FT. MSL (12/2/8
Top of Well Elevation 28.9 FT. MSL
Drill Type 6-IN HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, MOIST, LT. BROWN (10YR 6/4) | SW | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE, SLIGHT FUEL ODOR | SP-SW | 5+8 |
| | | 10-11.5 FT. | SAND, AS ABOVE | SP-SW | 11+15 |
| | | 15-16.5 FT. | SAND, AS ABOVE | SP-SW | 7+7 |
| | | 20-21.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY MIN., SATURATED, DK. BROWN (10YR 3/2), STRONG FUEL ODOR, OIL SHEEN VISIBLE ON WATER | SP-SW | 10+9 |

SHEET 1 OF 1

| | |
|---|---|
| Boring No. T6-2 | Location Coordinates N 386,819 |
| | E 1,660,404 |
| Hole Size 20.3 FT. x 6 IN. Slot 0.010 IN. | |
| Screen Size 14 FT. x 2 IN. Mat'l SCH. 40 PVC | Filter Materials NATIVE SAND |
| Casing Size 20.3 FT. x 2 IN. Mat'l SCH. 40 PVC | Grout Type SAND CEMENT |
| Geologist W. THIESS | Protective Casing 5 FT. x 6 IN. IRON |
| Date Start 11/8/83 Finish 11/8/83 | Static Water Level 21.4 FT. MSL (12/2/83) |
| Contractor WAR/WTD | Top of Well Elevation 24.6 FT. MSL |
| Driller P. WRIGHT | Drill Type 6-IN. HOLLOW STEM AUGER |




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG., 5% SILT + CLAY, TR. ORGANICS, WET, DK. BROWN (10YR 3/1) | SP | NA |
| | | 5-6.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND., 10% SILT + CLAY, TR. ORGANICS, SATURATED, BROWN w/ BLACK STREAKS (10YR 4/2) | SP | 14+16 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, LT. GRAY-BROWN (10YR 7/2) | SP-SW | 10+20 |
| | | 15-16.5 FT. | SAND, VF, QTZ., SUB ANG., 5% SILT + CLAY, SATURATED, BROWN (10YR 4/2) | SP-SW | 11+17 |
| | | 20-21.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB. RND., 10% SILT + CLAY, SATURATED, DK. BROWN (10YR 2/2), SLIGHT FUEL ODOR | SP-SW | 14+18 |

SHEET 1 OF 1

Boring No. T6-3

Hole Size 20.3 FT. x 6 IN Slot 0.010 IN

Screen Size 14 FT. x 2 IN Mat'l SCH. 40 PVC

Casing Size 20.3 FT. x 2 IN Mat'l SCH 40 PVC

Geologist W THIESS

Date Start 11/8/83 Finish 11/8/83

Contractor WAR /WTD

Driller P WRIGHT

Location Coordinates N 386,328

E 1,660,440

Filter Materials NATIVE SAND

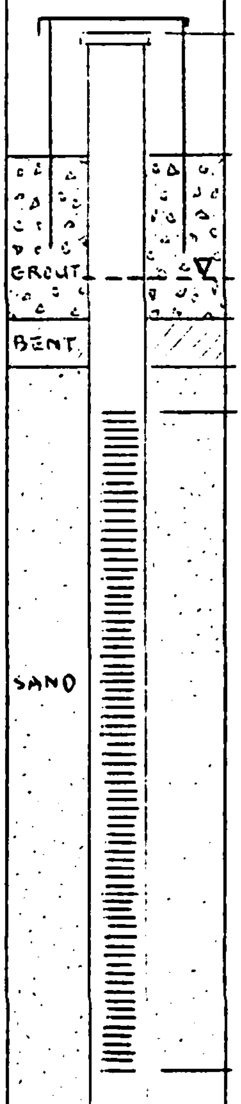
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 23.8 FT. MSL (12/2/8

Top of Well Elevation 24.0 FT. MSL

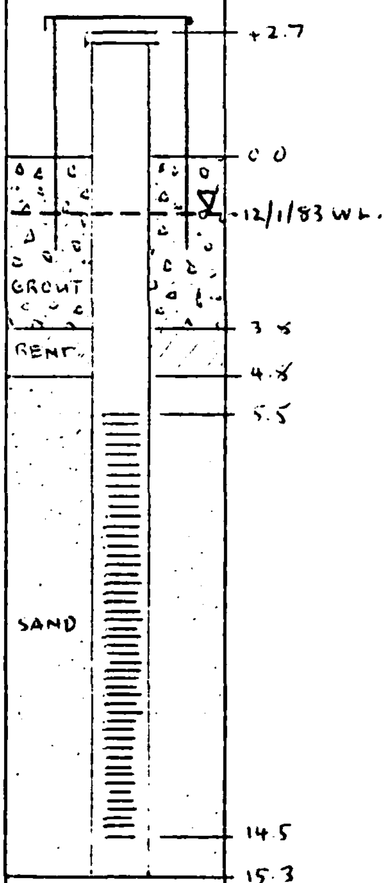
Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB. RND, TR. SILT + CLAY, TR. ORGANICS, MOIST, BROWN (10YR 3/2) | SP | NA |
| | +2.7 | | | | |
| | | 5-6.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. HVY. MIN., WET, LT. BROWN (10YR 7/3) STRONG FUEL ODOR | SP-SW | 4+4 |
| | 0.0 | | | | |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., SATURATED, WHITE, STRONG FUEL ODOR | SP-SW | 12+11 |
| | 12/2/83 W.L. | | | | |
| | 3.5 | | | | |
| | 4.5 | 15-16.5 FT. | SAND, AS ABOVE | SP-SW | 9+13 |
| | 5.5 | | | | |
| | | 20-21.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY MIN., SATURATED, LT. BROWN (10YR 5/2) STRONG FUEL ODOR | SP-SW | 10+14 |
| | 19.5 | | | | |
| | 20.3 | | | | |

SHEET 1 OF 1

Boring No. T7-1
Location Coordinates N 387 323
E 1,663 667
Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN.
Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC
Filter Materials NATIVE SAND
Casing Size 15.3 FT. x 2 IN. Mat'l SCH. 40 PVC
Grout Type SAND CEMENT
Geologist W. THIESS
Protective Casing 5 FT. x 6 IN. IRON
Date Start 11/6/83 Finish 11/6/83
Static Water Level 9.4 FT. MSL (12/1/83)
Contractor WAR/WTD
Top of Well Elevation 13.3 FT. MSL
Driller P. WRIGHT
Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, F, QTZ., SUB ANG, TR. SILT + CLAY, TR. ORGANICS, MOIST, GRAY (10YR 5/1) | SW | NA |
| | | 5-6.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, SATURATED, BLACK | SW | 5+7 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND, TR. SILT + CLAY, TR. ORGANICS, SATURATED, BROWN (10YR 4/2) | SW | 3+6 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, SATURATED, BROWN (10YR 4/2) | SW | 5+7 |

Boring No. T7-2

Hole Size 15.3 FT. x 6 IN. Slot 0.010 IN.

Screen Size 9 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 15.3 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/6/83 Finish 11/6/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 388,044 E 1,663,875

Filter Materials NATIVE SAND

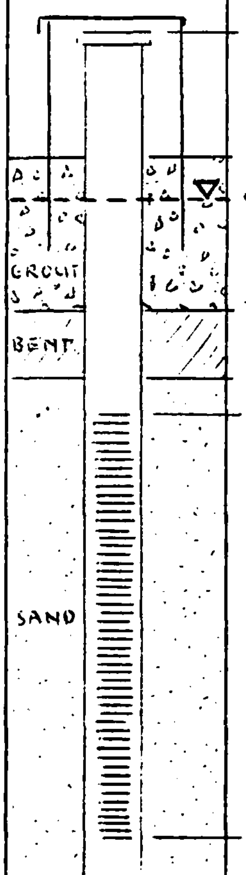
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 8.7 FT. MSL (12/1/83)

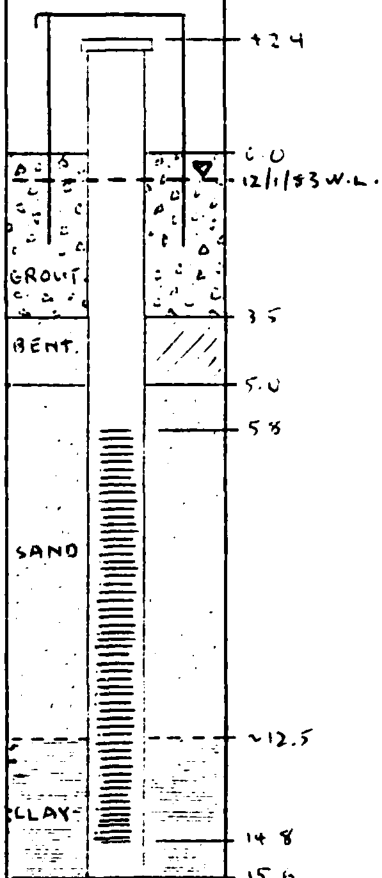
Top of Well Elevation 12.3 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
|  | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG - SUB. RND., TR. SILT + CLAY, TR. ORGANICS MOIST, BLACK | SW | NA |
| | +2.7 | 5-6.5 FT. | SAND, F, QTZ., SUB ANG, TR. SILT + CLAY TR. HVY. MIN., WET, WHITE W/ GRAY (10YR 7/1) STREAKS | SP-SW | 11+16 |
| | 0.0 | | | | |
| | 12/1/83 W.L. | 10-11.5 FT. | SAND, VF, QTZ., SUB ANG. - SUB RND., 5% SILT + CLAY, SATURATED, GRAY-BROWN (10YR 4/1) | SP-SW | 6+6 |
| | 3.25 | 15-16.5 FT. | SAND, VF, QTZ., SUB ANG - SUB RND., 30% SILT + CLAY, SATURATED, GRAY (7.5YR 6/1) | SP-SL | 1+3 |
| | 4.8 | | | | |
| | 5.5 | | | | |
| | 14.5 | | | | |
| | 15.3 | | | | |

SHEET 1 OF 1

| | |
|---|---|
| Boring No. T7-3 | Location Coordinates N 387,411 |
| Hole Size 15.5 FT. x 6 IN. Slot 0.010 IN | E 1,664,446 |
| Screen Size 9 FT x 2 IN. Mat'l SCH. 40 PVC | Filter Materials NATIVE SAND |
| Casing Size 15.5 FT. x 2 IN. Mat'l SCH. 40 PVC | Grout Type SAND CEMENT |
| Geologist W THIESS | Protective Casing 5 FT. x 6 IN. IRON |
| Date Start 11/6/83 Finish 11/6/83 | Static Water Level 7.9 FT. MSL (12/1/83) |
| Contractor WAR / WTD | Top of Well Elevation 10.9 FT MSL |
| Driller P WRIGHT | Drill Type 6-IN. HOLLOW STEM AUGER |




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND. TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. BROWN (10YR 3/1) | SW | NA |
| | | 5-6.5 FT. | SAND, AS ABOVE, SATURATED | SW | 13+16 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/2) | SW | 4+9 |
| | | 15-16.5 FT. | CLAY, PLASTIC, SATURATED, GRAY (7.5YR 5/1) | C | 0+0 |

SHEET 1 OF 1

Boring No. T8-1

Hole Size 15.3 FT × 6 IN Slot 0.010 IN.

Screen Size 9 FT. × 2 IN. Mat'l SCH. 40 PVC

Casing Size 15.3 FT. × 2 IN Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/4/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 397,780

E 1,654,564

Filter Materials NATIVE SAND

Grout Type SAND CEMENT

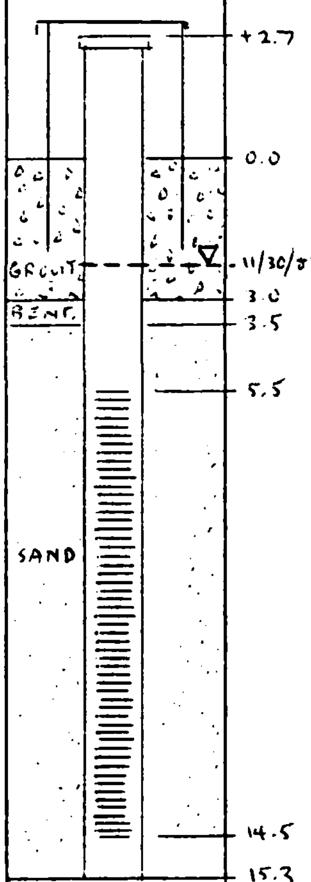
Protective Casing 5 FT. × 6 IN. IRON

Static Water Level 10.5 FT. MSL (11/30/83)

Top of Well Elevation 15.7 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF-F, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, TR. CALCAREOUS SHELL FRAGMENTS, MOIST, DK. GRAY-BROWN (10YR 3/1) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, VF-M, QTZ., SUB ANG., 5% SILT + CLAY, TR. CALCAREOUS SHELL FRAGMENTS, TR. ORGANICS, WET, LT. BROWN W/ ORANGE INCLUSIONS (10YR 7/3) | SP | 16+19 |
| | | | SAND, VF-F, QTZ., SUB ANG., 5% SILT + CLAY, WET, GRAY-BROWN W/ DK. GRAY STREAKS (10YR 5/1) | SP | 4+4 |
| | | | SAND, VF, QTZ., SUB ANG., 25% SILT + CLAY, SATURATED, GRAY (10YR 5/1) | SP-SL | 3+3 |



SHEET 1 OF 1

Boring No. T8-2

Hole Size 15.3 FT. × 6 IN. Slot 0.010 IN

Screen Size 9 FT. × 2 IN Mat'l SCH 40 PVC

Casing Size 15.3 FT. × 2 IN Mat'l SCH 40 PVC

Geologist W. THIESS

Date Start 11/5/83 Finish 11/10/83

Contractor WAR/WTD

Driller P. WRIGHT

Location Coordinates N 397,763

E 1,654,749

Filter Materials NATIVE SAND

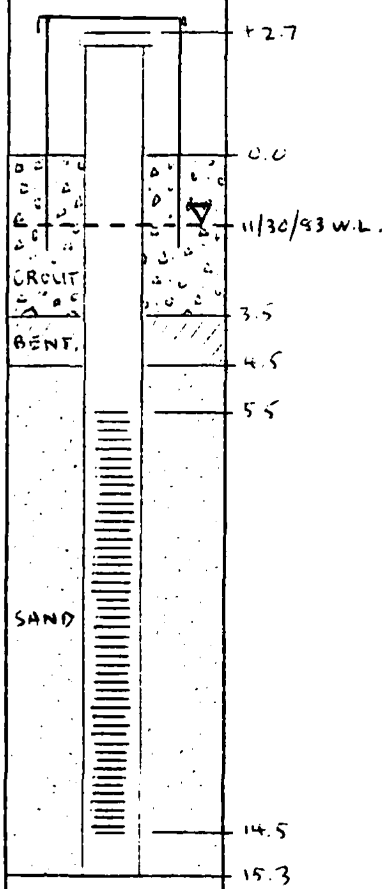
Grout Type SAND CEMENT

Protective Casing 5 FT. × 6 IN. IRON

Static Water Level 10.8 FT. MSL (11/30/83)

Top of Well Elevation 14.9 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER

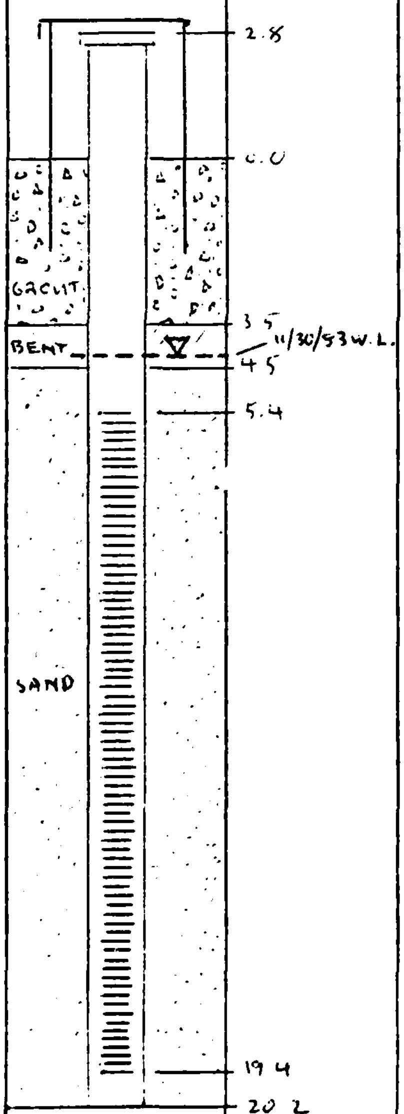



| Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|
| 0-1.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. GRAY (10YR 5/1) | SP | NA |
| 5-6.5 FT. | SAND, F-M, QTZ., SUB ANG., TR. SILT + CLAY, TR. HVY. MIN., TR. ORGANICS, WET, LT. GRAY (10YR 7/1) | SP-SW | 10+15 |
| 10-11.5 FT. | SAND, VF-F, QTZ., SUB ANG., 5% SILT + CLAY, TR. ORGANICS, SATURATED, GRAY-BROWN (10YR 5/1) | SP | 6+7 |
| 15-16.5 FT. | SAND, VF-F, QTZ., SUB ANG., 10% SILT + CLAY, TR. HVY. MIN., SATURATED, GRAY-BROWN (10YR 5/1) | SP | 2+2 |

Boring No. T9-1
Hole Size 20.2 FT. × 6 IN. Slot 0.010 IN.
Screen Size 14 FT. × 2 IN. Mat'l SCH. 40 PVC
Casing Size 20.2 FT. × 2 IN. Mat'l SCH. 40 PVC
Geologist W. THIESS
Date Start 11/8/83 Finish 11/8/83
Contractor WAR/WTD
Driller P. WRIGHT

Location Coordinates N 391,171
E 1,655,892
Filter Materials NATIVE SAND
Grout Type SAND CEMENT
Protective Casing 5 FT. × 6 IN. IRON
Static Water Level 13.8 FT. MSL (11/30/83)
Top of Well Elevation 20.7 FT. MSL
Drill Type 6-IN. HOLLOW STEM AUGER

| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. BROWN (10YR 2/1) | SP-SW | NA |
| | | 5-6.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, MOIST, DK. GRAY (10YR 5/1) | SP-SW | 9+15 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, WET, LT. BROWN (10YR 5/3) | SP-SW | 8+10 |
| | | 15-16.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/2) | SP | 6+8 |
| | | 20-21.5 FT. | SAND, VF-F, QTZ., SUB ANG.-SUB RND., 10% SILT + CLAY, SATURATED, BROWN (10YR 5/2) | SP | 3+3 |



SHEET 1 OF 1

Boring No. T9-2

Hole Size 20.1 FT. x 6 IN. Slot 0.010 IN.

Screen Size 14 FT. x 2 IN. Mat'l SCH. 40 PVC

Casing Size 20.1 FT. x 2 IN. Mat'l SCH. 40 PVC

Geologist W. THIESS

Date Start 11/11/83 Finish 11/11/83

Contractor WAR / WTD

Driller P. WRIGHT

Location Coordinates N 390,885

E 1,656,017

Filter Materials NATIVE SAND

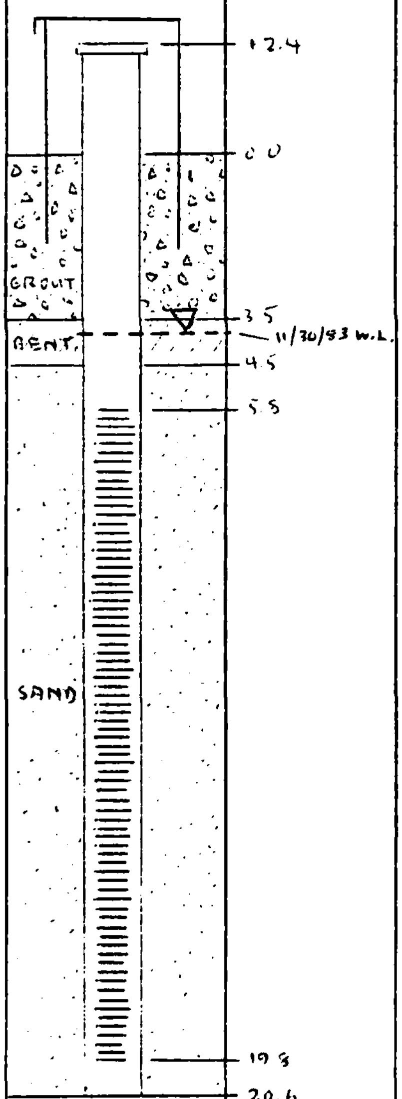
Grout Type SAND CEMENT

Protective Casing 5 FT. x 6 IN. IRON

Static Water Level 16.4 FT. MSL (11/30/83)

Top of Well Elevation 22.6 FT. MSL

Drill Type 6-IN. HOLLOW STEM AUGER




| Sketch | Depth (Feet) | Sample | Lithology | USCS | SPT (BL/FT) |
|---|---|---|---|---|---|
| | | 0-1.5 FT. | SAND, VF, QTZ., SUB ANG., TR. SILT + CLAY, TR. ORGANICS, MOIST, DK. GRAY-BROWN (10YR 3/2) | SP | NA |
| | | 5-6.5 FT. | SAND, VF-F, QTZ., SUB ANG., 10% SILT + CLAY, TR. ORGANICS, WET, DK. GRAY (10YR 2/1) | SP | 0+0 |
| | | 10-11.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, BROWN (10YR 5/3) | SP-SW | 12+8 |
| | | 15-16.5 FT. | SAND, VF, QTZ., SUB ANG.-SUB RND, 20% SILT + CLAY, SATURATED, BROWN (10YR 4/2), SLIGHT FUEL ODOR | SP | 2+2 |
| | | 20-21.5 FT. | SAND, F, QTZ., SUB ANG., TR. SILT + CLAY, SATURATED, LT. BROWN (10YR 6/2), SLIGHT FUEL ODOR | SP-SW | 2+4 |

# APPENDIX D

# FIELD RAW DATA

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDG/JWR
Date: 11/30/83
Time: 0805

Sampling Site/Well No.: ' - 1

Sampling Location Description: ANDFILL, WESTERN LOBE WESTERNMOST WELL, ~150 YDS. FROM SOUND

**Groundwater Samples**

Depth to water surface 6' 9 3/4"

Height of water column ______

pH 6.8

Sp. cond. 860 @ 22.5°C

**Surface Water and Sediment Samples**

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2, 4°C | |
| 15124 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2, 4°C | TP 1 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2, 4°C | MW 6 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X100, 101 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 1 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, DK. BRN.; SULFIDE ODOR, BAILER BLACKENED BY SULFIDE.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 11/30/83
Time: 0855

Sampling Site/Well No.: T1-2

Sampling Location Description: MAIN LANDFILL - WESTERN LOBE WELL ~ 100 YDS. EAST OF T1-1

**Groundwater Samples**

Depth to water surface: 8' 2½"

Height of water column: ______

pH: 6.8

Sp. cond.: 810 @ 22°C

**Surface Water and Sediment Samples**

Total Depth: ______

Sample Depth(s): ______

pH: ______

Sp. cond.: ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15125 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 2 |
| \| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 7 |
| \| | 40 ml glass | TOX ✓ | Chill to 4°C | X102 103 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 2 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, BRN. - BLK.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 11/30/83
Time: 0930

Sampling Site/Well No.: T1-3

Sampling Location Description: MAIN LANDFILL - WESTERN LOBE. WELL JUST OFF DIRT RD. TO SOUND (~200 YDS. TO SOUND), CLOSEST WELL TO DITCH THIS LOBE.

Groundwater Samples

Depth to water surface 5' 7½"

Height of water column ______

pH 7.0

Sp. cond. 720 @ 21.5°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15126 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 3 |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 3 |
| | 40 ml glass | TOX | Chill to 4°C | X 104, 105 |
| | 4 oz. plastic | DOC filter, | HCl to pH <2 | TOC 4 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER VERY TURBID, RED-BRN. SLIGHT SULFIDE ODOR.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1100

Sampling Site/Well No.: T1-4

Sampling Location Description: MAIN LANDFILL - EASTERN LOBE WELL ADJACENT TO DITCH SEPARATING LOBES

Groundwater Samples

Depth to water surface 12'3"

Height of water column ______

pH 6.2

Sp. cond. 332 @ 24°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15128 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 7 |
| ↓ | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 9 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | X112 113 |
| ↓ | 4 oz. plastic | DOC filter | HCl to pH <2 | TOC 8 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30 L BEFORE SAMPLING. PATCHY OILY SHEEN ON WATER. WATER TURBID & DK BRN., SEPTIC ODOR

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1235

Sampling Site/Well No.: T1-5
Sampling Location Description: MAIN LANDFILL - EASTERN LOBE

**Groundwater Samples**

Depth to water surface 7'2½"
Height of water column ____________
pH 5.9
Sp. cond. 123 @ 21°C

**Surface Water and Sediment Samples**

Total Depth ____________
Sample Depth(s) ____________
pH ____________
Sp. cond. ____________

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15129 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 8 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 1 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X114,115 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 5 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, CHOC. BRN. - REDDISH BRN., FOUL SMELLING (SEPTIC)

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project:
Project No.:
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1255

Sampling Site/Well No.: T1-6

Sampling Location Description: MAIN LANDFILL - EASTERN LOBE EASTERNMOST WELL.

Groundwater Samples

Depth to water surface 4'5"

Height of water column

pH 6.2

Sp. cond. 365 @ 21.5°C

Surface Water and Sediment Samples

Total Depth

Sample Depth(s)

pH

Sp. cond.

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15168 15179 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 5130, ~~15130~~ | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 9, 10, 11 |
| 4 | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 19, 20 |
| 4 | 40 ml glass | TOX | Chill to 4°C | X116-119 |
| 4 | 4 oz. plastic | DOC | HCl to pH <2 | TOC 3, 11 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID & FOAMY, DK BLK-BRN, FOUL SMELLING

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 11/30/83
Time: 1010

Sampling Site/Well No.: T1 EXISTING WELL

Sampling Location Description: MAIN LANDFILL - SPRAY IRRIGATION FIELD

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | | Total Depth | |
| Height of water column | ~ 30" | Sample Depth(s) | |
| pH | 6.8 | pH | |
| Sp. cond. | 277 @ 16°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15127 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 5 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 10 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X108, 109 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 9 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: WELL VERY SHALLOW (< 3 FT.), ~ 8" ~~CAP~~ GALVANIZED ALUMINUM WELL CASING; WATER TURBID, BRN & FOUL SMELLING (SEWAGE)

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB / JWR
Date: 11/30/83
Time: 1345

Sampling Site/Well No.: T1 SW1 & SEDIMENT

Sampling Location Description: MAIN LANDFILL - EASTERN LOBE UPSTREAM

**Groundwater Samples**

Depth to water surface ____________

Height of water column ____________

pH ____________

Sp. cond. ____________

**Surface Water and Sediment Samples**

Total Depth 18 - 24"

Sample Depth(s) SURFACE

pH 6.5

Sp. cond. 91 @ 17 °C

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15133 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 13 |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 2 |
| | 40 ml glass | TOX | Chill to 4°C | X122, 123 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 14 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| 15167 | 1 qt. glass | Pesticides, ~~PCBs, Herbicides, Oil & Grease~~ TOX, Metals | Chill to 4°C | ~~DDT 2 B24, MS 2~~ DDT 3 MS 3 |

TAKEN 12/2[illegible]

Comments and additional observations: ~~SOIL SAMPLED @ 2 FT. DEPTH~~

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB/JWR
Date: 12/2/83
Time: 1550

Sampling Site/Well No.: T1 SW2

Sampling Location Description: MAIN LANDFILL - EASTERN LOBE UPSTREAM OF SUSPECT AREA

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | | Total Depth | 18 - 24" |
| Height of water column | | Sample Depth(s) | SURFACE |
| pH | | pH | 6.0 |
| Sp. cond. | | Sp. cond. | 185 @ 20°C |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15134 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 33 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 33 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X152, 153 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 38 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: WATER SLIGHTLY STAGNANT, PATCHY OILY FILM BEGINNING ~~OF~~ OF FLOCCULENT, ~~&~~ GELATINOUS TAN MATERIAL ABOUT 3-6' DOWNSTREAM FROM SAMPLING PT. WATER CLEAR, AMMONIA-TYPE PUNGENT ODOR WHEN STIRRED.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1110

Sampling Site/Well No.: TI SW3, NEAR 1-4 ~~SEDIMENT~~ & SEDIMENT
Sampling Location Description: MAIN LANDFILL - EASTERN LOBE ACCESS, DITCH SAMPLE

**Groundwater Samples**

Depth to water surface ____

Height of water column ____

pH ____

Sp. cond. ____

**Surface Water and Sediment Samples**

Total Depth 18-20"

Sample Depth(s) ____

pH 6.5

Sp. cond. 202 @ 19.5°C

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15131 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP6 |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW4 |
| | 40 ml glass | TOX | Chill to 4°C | X110, 111 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 7 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| 15165 | 1 qt. glass | Pesticides, ~~PCBs~~, TOX Herbicides, ~~Oil & Grease~~ Metals | Chill to 4°C | DDT 3 MS 4 |

TAKEN 12/2/83 1615

Comments and additional observations: ____

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1305

Sampling Site/Well No.: T1 SW4, SEDIMENT

Sampling Location Description: MAIN LANDFILL - EASTERN LOBE, DOWNSTREAM

**Groundwater Samples**

Depth to water surface ____________

Height of water column ____________

pH ____________

Sp. cond. ____________

**Surface Water and Sediment Samples**

Total Depth 8-10"

Sample Depth(s) SURFACE

pH 6.5

Sp. cond. 231 @ 20°C

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15132 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 12 |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW5 |
| | 40 ml glass | TOX | Chill to 4°C | X120, 121 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 12 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| 15166 | 1 qt. glass | Pesticides, ~~PCBs,~~ TOX ~~Herbicides, Oil & Grease~~ ~~TOC~~, Metals | Chill to 4°C | DDT 1 ~~B20~~, MS1 |

DDT 4
MS 6

TAKEN 12/2
1630

Comments and additional observations: ____________

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RAB/JWR
Date: 12/2/83
Time: 2000

Sampling Site/Well No.: LH2-1

Sampling Location Description: LYNN HAVEN FUEL STORAGE WEST SIDE, OUTSIDE FENCE & CLOSEST TO GATE

Groundwater Samples

Depth to water surface 5' 8 1/4"

Height of water column ______

pH 6.3 5.0

Sp. cond. 30 @ 21.5°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15135 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | OG 3 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 48 |
| | 40 ml glass | TOX | Chill to 4°C | X156, 157 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 43 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, TAN-BRN. (SANDY), SULFIDE ODOR AND SLIGHTLY BLACKENED BAILER.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 12/2/83
Time: 1930

Sampling Site/Well No.: LH2-2

Sampling Location Description: LYNN HAVEN FUEL STORAGE, WEST SIDE, OUTSIDE FENCE, CLOSEST TO BAY

Groundwater Samples

Depth to water surface 4' 10 3/4"

Height of water column ______

pH 4.6 3.65

Sp. cond. 51 @ 21°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15136 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 2 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 40 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X158,159 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 39 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILER PLUGGED WITH CLAY. BAILED 30L BEFORE SAMPLING WATER TURBID TAN-BRN, NO ODOR OR VISIBLE OIL ON SURFACE.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project:
Project No.:
Sampled by: RDB/JWR
Date: 12/2/83
Time: 2020

Sampling Site/Well No.: LH2-3

Sampling Location Description: LYNN HAVEN FUEL STORAGE, NORTH SIDE, WESTERNMOST WELL, 3 FT. FROM

Groundwater Samples

Depth to water surface 5' 6 1/4"

Height of water column

pH 7.8 6.7

Sp. cond. 310 @ 21°C

Surface Water and Sediment Samples

Total Depth

Sample Depth(s)

pH

Sp. cond.

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15137 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | OG 4 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 45 |
| | 40 ml glass | TOX | Chill to 4°C | X154 155 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 44 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED DRY @ 10L.

TYNDALL AFB FIELD SAMPLE SHEET

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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 12/2/83
Time: 2030

Sampling Site/Well No.: LH2-4

Sampling Location Description: LYNN HAVEN FUEL STORAGE NORTH SIDE, ~~EASTERNMOST~~ MIDDLE WELL ~ 25 FT. FROM FENCE BY BAY

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 5'9 1/4" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 6.1 | pH | |
| Sp. cond. | 426 @ 21°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15138 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 5 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 41 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X160, 161 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 40 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, TAN-BRN-(SANDY), NO VISIBLE FUEL OR OIL PRESENT, NO ODOR

TYNDALL AFB FIELD SAMPLE SHEET

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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB/JWR
Date: 12/2/83
Time: 2100

Sampling Site/Well No.: LH2-5

Sampling Location Description: LYNN HAVEN FUEL STORAGE NORTH SIDE, EASTERNMOST WELL ~ 35 FT. FROM FENCE BY BAY.

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 5'3" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 6.2 | pH | |
| Sp. cond. | 184 @ 22°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15139 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | OG 6 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 44 |
| | 40 ml glass | TOX | Chill to 4°C | X162, 163 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 42 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED DRY @ 18L. WATER TURBID, GREY-BRN., NO OIL OR FUEL VISIBLE ON SURFACE.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWK
Date: 12/2/83
Time: 2110

Sampling Site/Well No.: LHZ-6

Sampling Location Description: LYNN HAVEN FUEL STORAGE, EAST WELL

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 6' 1" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 5.65 | pH | |
| Sp. cond. | 287 @ 23°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15140, 15169, 15171 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | OG 7, 8 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | MW 41 |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 43, 38 |
| | 40 ml glass | TOX | Chill to 4°C | X164, 165, 166, 167 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 41 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, LT. TAN (MILKY BRN), NO ODOR OR VISIBLE FUEL/OIL LAYER ON SURFACE.

TYNDALL AFB FIELD SAMPLE SHEET

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Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No. ______
Sampled by: RDB/JWR
Date: 12/2/83
Time: 2130

Sampling Site/Well No.: LH2-7

Sampling Location Description: LYNN HAVEN FUEL STORAGE SOUTHERN WELL, BETWEEN RAIL LINES & FENCE

**Groundwater Samples**

Depth to water surface 5' 5½"

Height of water column ______

pH 5.1

Sp. cond. 125 @ 22°C

**Surface Water and Sediment Samples**

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15141 | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | OG 9 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 39 |
| | 40 ml glass | TOX | Chill to 4°C | X168, 169 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 10 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, GREY-BRN. (SANDY), SLIGHT SEPTIC/SULFIDE ODOR, NO FUEL/OIL LAYER VISIBLE.

TYNDALL AFB FIELD SAMPLE SHEET

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Phone: 904/372-1500

Project:
Project No.:
Sampled by: RDB/JWR
Date: 12/1/83
Time: 1650

Sampling Site/Well No.: T3-1

Sampling Location Description:

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 6' 2½" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 5.7 5.35 | pH | |
| Sp. cond. | 124 @ 20.5°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15142, 15170 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 13, 16 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 15142 | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 28 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X144, 145, 170, 17 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 31 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, LT. TAN.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB/JWR
Date: 12/1/83
Time: 1620

Sampling Site/Well No.: T3-2

Sampling Location Description: SITE 14 (POL Area), adjacent to Small Arms Repairs

Groundwater Samples

Depth to water surface 5'7½"

Height of water column ____

pH 5.6 5.3

Sp. cond. 105 @ 21.5°C

Surface Water and Sediment Samples

Total Depth ____

Sample Depth(s) ____

pH ____

Sp. cond. ____

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15143 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 14 |
| \| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 46 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X140, 141 |
| Y | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 28 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RCB/JWR
Date: 12/1/83
Time: 1640

Sampling Site/Well No.: T3-3
Sampling Location Description: ______

**Groundwater Samples**

Depth to water surface 4' 8 1/4"
Height of water column ______
pH 5.9 5.7
Sp. cond. 184 @ 20.5 °C

**Surface Water and Sediment Samples**

Total Depth ______
Sample Depth(s) ______
pH ______
Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15144 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 15 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 31 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X142, 143 |
| V | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 27 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, GREY-BLK, SEPTIC ODOR

TYNDALL AFB FIELD SAMPLE SHEET

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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: 
Project No.: 
Sampled by: RDB/JWR
Date: 12/1/83
Time: 1705

Sampling Site/Well No.: T3-4

Sampling Location Description: 

Groundwater Samples

Depth to water surface 11' 2 1/2"

Height of water column 

pH 6.2

Sp. cond. 415 @ 19°C

Surface Water and Sediment Samples

Total Depth 

Sample Depth(s) 

pH 

Sp. cond. 

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| 15145 | 1 qt. glass | Oil & Grease ✓ | HCl to pH<2,4°C | OG 1 |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 15 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X146, 147 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 29 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED DRY @ ~3-4L BAILED 3X BEFORE SAMPLING OVER ~90 MIN. PERIOD.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB / JWR
Date: 12/2/83
Time: 0940

Sampling Site/Well No.: T3 EXISTING WELL
Sampling Location Description: ____________

**Groundwater Samples**

Depth to water surface UNKNOWN
Height of water column ____________
pH 7.0
Sp. cond. 310 @ 22.5°C

**Surface Water and Sediment Samples**

Total Depth ____________
Sample Depth(s) ____________
pH ____________
Sp. cond. ____________

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | |
| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC. | HCl to pH <2 | |
| 15146 | 40 ml glass | Purgeables | Chill to 4°C | P011 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: LET WELL PUMP CYCLE TWICE BEFORE SAMPLING.

# TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB / JWR
Date: 12/3/83
Time: 0020

Sampling Site/Well No.: T4-1

Sampling Location Description: AFEES Service Station

**Groundwater Samples**

Depth to water surface 8'6"

Height of water column ____

pH ____

Sp. cond. ____

**Surface Water and Sediment Samples**

Total Depth ____

Sample Depth(s) ____

pH ____

Sp. cond. ____

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | |
| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC | HCl to pH <2 | |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: No fuel present.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 12/1/83
Time: 1500

Sampling Site/Well No.: TS-1

Sampling Location Description: ______

Groundwater Samples

Depth to water surface 7' 3/16"

Height of water column ______

pH 5.4

Sp. cond. 78 @ 22.5°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

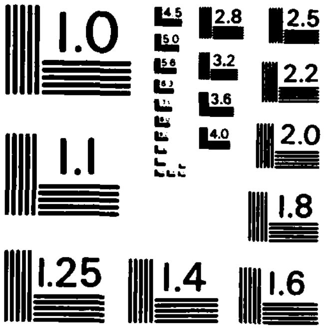
| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 15147 | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MU'37 |
| ↓ | 40 ml glass | TOX ✓ | Chill to 4°C | X132, 133 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 37 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30 L BEFORE SAMPLING. WATER TURBID, TAN-BRN.

AD-A147 465 INSTALLATION RESTORATION PROGRAM PHASE II CONFIRMATION/QUANTIFICATION STA..(U) WATER AND AIR RESEARCH INC GAINESVILLE FL W G THIESS ET AL. AUG 84 7166 (110) F33615-81-D-4007

3/3

UNCLASSIFIED F/G 13/2 NL




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

## TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWK
Date: 12 / 1 / 83
Time: 1530

Sampling Site/Well No.: TS-2
Sampling Location Description: SMALL ARM REPAIR

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 7' 5½" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 4.6 | pH | |
| Sp. cond. | 172 @ 22°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 15148 | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW35 |
| ↓ | 40 ml glass | TOX ✓ | Chill to 4°C | X135,134 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 15 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, TAN-BRN. (SANDY SILT).

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB/JWR
Date: 12/1/83
Time: 1550

Sampling Site/Well No.: TS-3

Sampling Location Description: ____

**Groundwater Samples**

Depth to water surface 6'3"

Height of water column ____

pH 5.5

Sp. cond. 230 @ 22°C

**Surface Water and Sediment Samples**

Total Depth ____

Sample Depth(s) ____

pH ____

Sp. cond. ____

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 5149, 15171 15178 | 1 plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 34, 36 MW 50 |
| | 40 ml glass | TOX | Chill to 4°C | X136-139 |
| | 4 oz. plastic | DOC | HCl to pH <2 | TOC 24, 25 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30 L BEFORE SAMPLING. WATER VERY TURBID

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 12/2/83
Time: 1500

Sampling Site/Well No.: TG-1
Sampling Location Description: DRUM DISPOSAL AREA

**Groundwater Samples**

Depth to water surface 5' ½"
Height of water column ______
pH 6.2
Sp. cond. 233 @ 20°C

**Surface Water and Sediment Samples**

Total Depth ______
Sample Depth(s) ______
pH ______
Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 19150 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 27 |
| \| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 30 |
| \| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 33 |
| V | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO5 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, BLACK & SMELLY (SOUR & SEPTIC). FULL DRUMS VISIBLE IN WOODS ~30 FT. FROM WELL SITE. SHALLOW DUMP BASIN HAD CLUMPS OF BLACK SLUDGE MATERIAL DRIED ON BOTTOM.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB
Date: 12/2/83
Time: 1025

Sampling Site/Well No.: T6-2

Sampling Location Description: ____

**Groundwater Samples**

Depth to water surface 3'2½"

Height of water column ____

pH 4.5

Sp. cond. 65 @ 21°C

~~**Surface Water and Sediment Samples**~~

~~Total Depth ____~~

~~Sample Depth(s) ____~~

~~pH ____~~

~~Sp. cond. ____~~

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2, 4°C | |
| 19151 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2, 4°C | TP 26 |
| ↓ | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2, 4°C | MW 24 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | |
| ↓ | 4 oz. plastic | DOC | HCl to pH <2 | TOC 34 |
| ↓ | 40 ml glass | Purgeables | Chill to 4°C | PO 6 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: PUMPED 30L WITH HAND PUMP (GUZZLER) BEFORE SAMPLING.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project:
Project No.:
Sampled by: RDR / JWR
Date: 12/2/83
Time: 1520

Sampling Site/Well No.: T6-3
Sampling Location Description:

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 5'3" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 6.2 | pH | |
| Sp. cond. | 248 @ 21°C | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2, 4°C | |
| 19152, 19172, 19175 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2, 4°C | TP 28, 29, 30 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2, 4°C | MW 21, 22, MW 5 |
| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 35, 36 |
| | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO 4, 3 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, BLK-BRN c̄ OILY FILM ON SURFACE, FUEL/OIL ODOR.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB / JWR
Date: 12/1/83
Time: 0750

Sampling Site/Well No.: T7-1

Sampling Location Description: ____

**Groundwater Samples**

Depth to water surface 3' 10½"

Height of water column ____

pH 4.6

Sp. cond. 69 @ 20°C

**Surface Water and Sediment Samples**

Total Depth ____

Sample Depth(s) ____

pH ____

Sp. cond. ____

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15154 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP16 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 25 |
| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 20 |
| | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO 9 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER VERY TURBID, CHOC. BRN., SULFIDE ODOR.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB / JWR
Date: 12 / 1 / 83
Time: 0925

Sampling Site/Well No.: T7-2

Sampling Location Description: ____

**Groundwater Samples**

Depth to water surface 3' 7"

Height of water column ____

pH 4.5

Sp. cond. 60 @ 19.5 °C

~~**Surface Water and Sediment Samples**~~

~~Total Depth ____~~

~~Sample Depth(s) ____~~

~~pH ____~~

~~Sp. cond. ____~~

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 19155 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 18 |
| ↓ | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 12 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 23 |
| ↓ | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO 7 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED ~25L BEFORE SAMPLING. WATER TURBID, GREY-BRN., SEPTIC ODOR. VERY MUDDY, BOGGY CONDITIONS AT SITE.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____
Project No.: ____
Sampled by: RDB/JWR
Date: 12/1/83
Time: 1350

Sampling Site/Well No.: T7-3
Sampling Location Description: ____

**Groundwater Samples**

Depth to water surface 7'0"
Height of water column ____
pH 4.5
Sp. cond. 90 @ 20.5°C

**Surface Water and Sediment Samples**

Total Depth ____
Sample Depth(s) ____
pH ____
Sp. cond. ____

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15156, 15173, 15176 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 19, 20, 21 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 27, 29 |
| | 40 ml glass | TOX | Chill to 4°C | |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 22, 26 |
| | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO 10 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER VERY TURBID, ~~GREY~~ BRN - BLK.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB / JWR
Date: 12/1/83
Time: 0850

Sampling Site/Well No.: T7 Potable well

Sampling Location Description: ______

Groundwater Samples

Depth to water surface ______

Height of water column ______

pH 7.1

Sp. cond. 1090 @ 20.5°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15153 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 17 |
| ↓ | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 32 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 21 |
| ↓ | 40 ml glass | Purgeables ✓ | Chill to 4°C | PO 8 |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ~50 g storage tank (pressurized), faucet flow @ ~10 g/min. Let run for 6-7 min. to purge tank.

TYNDALL AFB FIELD SAMPLE SHEET

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P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1620

Sampling Site/Well No.: T8-1
Sampling Location Description: 6000 AREA LANDFILL

| Groundwater Samples | | Surface Water and Sediment Samples | |
|---|---|---|---|
| Depth to water surface | 4' 10½" | Total Depth | |
| Height of water column | | Sample Depth(s) | |
| pH | 6.8 | pH | |
| Sp. cond. | 382 @ 20°C<br>490 (on x10) | Sp. cond. | |

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 19157 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 14 |
| ↓ | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 16 |
| ↓ | 40 ml glass | TOX ✓ | Chill to 4°C | X124, 125 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 13 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED DRY @ 9 L BEFORE SAMPLING. WATER TURBID & GREY-BRN.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1650

Sampling Site/Well No.: T8-2

Sampling Location Description: AREA 6000 LANDFILL

**Groundwater Samples**

Depth to water surface: 4' 1½"

Height of water column: ____________

pH: 5.2

Sp. cond.: 71 @ 20°C

**Surface Water and Sediment Samples**

Total Depth ____________

Sample Depth(s) ____________

pH ____________

Sp. cond. ____________

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15158 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 15 |
| ↓ | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 17 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | X126,127 |
| ↓ | 4 oz. plastic | DOC | HCl to pH <2 | TOC 17 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED ~26 L BEFORE SAMPLING. WATER SAME AS 8-1.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1700

Sampling Site/Well No.: T9-1

Sampling Location Description: ______

Groundwater Samples

Depth to water surface 6'11"

Height of water column ______

pH 4.8

Sp. cond. 95 @ 23°C

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 19159 | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 13 |
| ↓ | 40 ml glass | TOX ✓ | Chill to 4°C | X128, 129 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 16 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: BAILED 30L BEFORE SAMPLING. WATER TURBID, BRN.-BLK. & SULFIDE ODOR.

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB/JWR
Date: 11/30/83
Time: 1720

Sampling Site/Well No.: T9-2

Sampling Location Description: ____________

**Groundwater Samples**

Depth to water surface 6'2½"

Height of water column ____________

pH 5.3

Sp. cond. 72 @ 20.5°C

**~~Surface Water and Sediment Samples~~**

~~Total Depth ____________~~

~~Sample Depth(s) ____________~~

~~pH ____________~~

~~Sp. cond. ____________~~

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | |
| 15160 | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 18 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | X130, 131 |
| ↓ | 4 oz. plastic | DOC | HCl to pH <2 | TOC 18 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ____________

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: RDB / JWR
Date: 12/2/83
Time: 1245

Sampling Site/Well No.: T10-1

Sampling Location Description: SITE 16 - FIRE TRAINING AREA, WESTERNMOST WELL, IN FRONT OF OYSTER SHELL BANK

Groundwater Samples

Depth to water surface ~12-14'

Height of water column ____________

pH 7.4

Sp. cond. ____________

~~Surface Water and Sediment Samples~~

Total Depth ____________

Sample Depth(s) ____________

pH ____________

Sp. cond. ____________

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 1916! | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 24 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 23 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X172, 173 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 6 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ____________

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RDB/JWR
Date: 12/2/83
Time: 1320

Sampling Site/Well No.: T10-2

Sampling Location Description: SITE 16 - FIRE TRAINING AREA, ~40' ~~SW~~ SE OF 10-1

Groundwater Samples

Depth to water surface ~12-14'

Height of water column ______

pH 7.1

Sp. cond. ______

Surface Water and Sediment Samples

Total Depth ______

Sample Depth(s) ______

pH ______

Sp. cond. ______

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 15162 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2,4°C | TP 25 |
| | 1 l plastic | Heavy Metals ✓ | $HNO_3$ to pH<2,4°C | MW 26 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X174, 175 |
| | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 30 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ______

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ______
Project No.: ______
Sampled by: RAB/JWR
Date: 12/2/83
Time: 1325

Sampling Site/Well No.: T10-3
Sampling Location Description: SITE 16 - FIRE TRAINING AREA

Groundwater Samples

Depth to water surface ~12 FT
Height of water column ______
pH 7.3
Sp. cond. 128 @ 20.5°C

~~Surface Water and Sediment Samples~~

~~Total Depth ______~~
~~Sample Depth(s) ______~~
~~pH ______~~
~~Sp. cond. ______~~

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2,4°C | |
| 19163 | 1 qt. glass | Phenols | $H_2SO_4$ to pH<2,4°C | TP 22 |
| ↓ | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2,4°C | MW 11 |
| ↓ | 40 ml glass | TOX | Chill to 4°C | X148, 149 |
| ↓ | 4 oz. plastic | DOC | HCl to pH <2 | TOC 19 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ______

TYNDALL AFB FIELD SAMPLE SHEET

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, FL 32602
Phone: 904/372-1500

Project: ____________
Project No.: ____________
Sampled by: ROB/JWR
Date: 12/2/83
Time: 1345

Sampling Site/Well No.: T10-4

Sampling Location Description: SITE 16 - FIRE TRAINING AREA, EASTERNMOST PIT WELL

**Groundwater Samples**

Depth to water surface ~12 FT.

Height of water column ____________

pH 7.8

Sp. cond. 231 @ 20.5°C

**Surface Water and Sediment Samples**

Total Depth ____________

Sample Depth(s) ____________

pH ____________

Sp. cond. ____________

| Sample No. | Container | Parameters to be Analyzed | Preservation Method | Container No. |
|---|---|---|---|---|
| | | Water Samples | | |
| | 1 qt. glass | Pesticides, PCBs | Chill to 4°C | |
| | 1 qt. glass | Herbicides | Chill to 4°C | |
| | 1 qt. glass | Oil & Grease | HCl to pH<2, 4°C | |
| 15164 | 1 qt. glass | Phenols ✓ | $H_2SO_4$ to pH<2, 4°C | TP 23 |
| ' | 1 l plastic | Heavy Metals | $HNO_3$ to pH<2, 4°C | MW 14 |
| | 40 ml glass | TOX ✓ | Chill to 4°C | X150, 151 |
| ↓ | 4 oz. plastic | DOC ✓ | HCl to pH <2 | TOC 32 |
| | 40 ml glass | Purgeables | Chill to 4°C | |
| | | Sediment Samples | | |
| | 1 qt. glass | Pesticides, PCBs, Herbicides, Oil & Grease | Chill to 4°C | |

Comments and additional observations: ____________

# APPENDIX E

## SAMPLING AND ANALYTICAL PROCEDURES

## APPENDIX E

## QUALITY ASSURANCE/QUALITY CONTROL PLAN

### E-1.0 ANALYTICAL QUALITY CONTROL

All field sampling and quality control spiking were performed by WAR. All sample analyses, with the exception of TOX, were performed by TSI. TOX analyses were performed by UBTL. Each of the above organizations maintains a strict quality assurance/quality control (QA/QC) plan which is outlined in a detailed document. These QA/QC documents were not appended in this report due to their length. This appendix outlines QA/QC procedures directly relevant to the Tyndall AFB Phase IIb survey.

Accuracy of analytical techniques was assured by strict adherence to the methods listed in Table E-1. Samples analyzed for purgeable organics were analyzed past the 14-day holding time recommended by EPA. Extended holding times for these samples should not have a significant effect on the analytical results or the conclusions and recommendations based on those results, as discussed in Section E-4.0. Holding times for all other parameters were met.

Inductively Coupled Plasma Spectrometry (ICP) was used for lead analyses in an effort to minimize matrix interferences that impact ICP less than atomic absorption spectrophotometry. Use of ICP resulted in a detection limit of 30 ug/l instead of 20 ug/l as specified in the scope of work. Since a diversity of matrix interferences were anticipated, the ICP method was believed capable of providing better quality data that would outweigh the slightly higher detection limit. The 30 ug/l detection limit attained is well below the 50 ug/l MCL for lead.

Integrity and representativeness of samples was assured by sampling procedures described in Section E-2.0. A check on analytical quality control was provided for by duplicating a minimum of 10 percent of the samples in each analysis lot. Additional samples were collected to provide for spiking 10 percent of total phenolics and metals samples.

Table E-1. Analytical Chemistry Methods for Water Samples, Tyndall AFB

| Parameter | Method | Detection Limit |
|---|---|---|
| pH* | EPA 150.1 | — |
| Specific conductance* | EPA 120.1 | — |
| Temperature* | EPA 170.1 | — |
| TOC | EPA 415.1 | 1 mg/l |
| TOX | EPA 9020† | 10 |
| Oil and grease | EPA 413.2 | 0.1 mg/l |
| Total phenolics | EPA 420.1 | 1 |
| DDT isomers | EPA 608†† | 0.02 each |
| Cadmium | EPA 200.7 | 5 |
| Chromium | EPA 200.7 | 10 |
| Iron | EPA 200.7 | 7 |
| Lead | EPA 200.7 | 30 |
| Nickel | EPA 200.7 | 20 |
| Zinc | EPA 200.7 | 10 |
| VOH | EPA 601†† | ** |
| VOA | EPA 602†† | ** |

All detection limits are in ug/l units except where noted.

Note: EPA = U.S. EPA "Methods for Chemical Analysis of Water and Wastes," March 1979—Method Number.

*Performed at the time of sample collection.
†EPA = EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 2nd Edition, 1982.
**See Table 12 for detection limits.
††EPA = EPA "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", July 1982—Method Number.

Samples for TOC, TOX, oil and grease, VOA, and VOH were not spiked. Duplicate and spike samples were labelled in such a way that the analytical laboratory could not identify them. Results of duplicate and spike analyses are shown in Table E-2.

Spike recoveries for total phenolics and metals were all in the range of 91 to 107 percent with the exception of the phenol spike in the sample from well No. T7-3. The high spike recovery of 162 percent recorded for this sample may be partially attributed to variability in the field duplicate receiving the spike. This sample was the low spike (5 ug/l) and the background total phenolic concentration was also low (6 ug/l), therefore, variability of several ug/l in the third duplicate receiving the spike would raise the calculated spike recovery significantly.

Duplicate samples for metals (location Nos. T1-6, T5-3, T6-3, and T7-3) were in excellent agreement with each other. Duplicates for total phenolics were also in excellent agreement. DOC duplicates were in good agreement with the exception of the samples from well No. T6-3. Poor duplication here is probably a result of the difficulty in obtaining a representative sample from a nonhomogeneous matrix (an oil sheen was visible on the water). This may also be the reason for poor duplication of the oil and grease analysis for samples from well No. T3-1. TOX duplicates for the sediment sample at location No. T1-Sed 2 are in reasonable agreement. All TOX duplicates for water samples are in good agreement.

There is some discrepancy in the duplicate sample for purgeable organics (see Table 11). This is most likely due to nonhomogeneity of the sample, which had a visible oil sheen. A significant portion of the purgeable organics in the sample would be associated with the oil sheen. Distribution of an equal amount of this surface film into the duplicate samples was not possible.

Table E-2. Analytical Quality Control Data (Page 1 of 2)

| Sample Location No. | Sample Type | Lab Sample No. | Total Phenolics ug/l | Metals, ug/l (water) or ug/kg (sediment) | | | | | | DOC mg/l | TOX ug Cl/l | Oil and Grease ug/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cd | Cr | Fe | Ni | Pb | Zn | | | |
| T1-6 | Groundwater | 15168 | 18 | <5 | <10 | 49,900 | <20 | <30 | <10 | 16.6 | 170 | - |
| | Phenol spike | 15130 | 46 | <5 | <10 | 44,000 | <20 | <30 | 12 | 18.8 | 160 | - |
| | Spike target conc.* | - | 43 | - | - | - | - | - | - | - | - | - |
| | Percent recovery† | - | 107 | - | - | - | - | - | - | - | - | - |
| | Metals spike | 15174 | 18 | 100 | 203 | 45,960 | 980 | 198 | 515 | - | - | - |
| | Spike target conc. | - | - | 98 | 195 | 977 | 977 | 195 | 489 | - | - | - |
| | Percent recovery | - | - | 102 | 104 | -** | 100 | 102 | 103 | - | - | - |
| T1-SED2 | Sediment | 15165 | - | - | 2,880 | - | - | 11,500 | - | - | 5,200 | - |
| | Field duplicate | 15178 | - | - | - | - | - | - | - | - | 3,700 | - |
| LH2-6 | Groundwater | 15140 | - | - | - | - | - | <30 | - | - | 140 | <100 |
| | Field duplicate | 15169 | - | - | - | - | - | <30 | - | - | 140 | <100 |
| | Pb spike | 15177 | - | - | - | - | - | 165 | - | - | - | - |
| | Spike target conc. | - | - | - | - | - | - | 182 | - | - | - | - |
| | Percent recovery | - | - | - | - | - | - | 91 | - | - | - | - |
| T3-1 | Groundwater | 15142 | - | - | - | - | - | - | - | - | 90 | <100 |
| | Field duplicate | 15170 | - | - | - | - | - | - | - | - | 110 | 300 |
| T5-3 | Groundwater | 15149 | - | - | <10 | - | - | <30 | - | 2.2 | 100 | - |
| | Field duplicate | 15171 | - | - | <10 | - | - | <30 | - | 1.7 | 120 | - |
| | Pb spike | 15178 | - | - | 203 | - | - | 190 | - | - | - | - |
| | Spike target conc. | - | - | - | 189 | - | - | 189 | - | - | - | - |
| | Percent recovery | - | - | - | 107 | - | - | 100 | - | - | - | - |

Table E-2. Analytical Quality Control Data (Page 2 of 2)

| Sample Location No. | Sample Type | Lab Sample No. | Total Phenolics ug/l | Metals, ug/l (water) or ug/kg (sediment) Cd | Cr | Fe | Ni | Pb | Zn | DOC mg/l | TOX ug Cl/l | Oil and Grease ug/l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T6-3 | Groundwater | 15152 | 54 | – | – | – | – | 31 | – | 38.2 | – | – |
| | Phenol spike | 15172 | 62 | – | – | – | – | <30 | – | 116 | – | – |
| | Spike target conc. | – | 61 | – | – | – | – | – | – | – | – | – |
| | Percent recovery | – | 102 | – | – | – | – | – | – | – | – | – |
| | Pb spike | 15175 | 47 | – | – | – | – | 180 | – | – | – | – |
| | Spike target conc. | – | – | – | – | – | – | 190 | – | – | – | – |
| | Percent recovery | – | – | – | – | – | – | 95 | – | – | – | – |
| T7-3 | Groundwater | 15156 | 8 | – | – | – | – | <30 | – | 141 | – | – |
| | Field duplicate | 15173 | 8 | – | – | – | – | <30 | – | 171 | – | – |
| | Phenol spike | 15176 | 21 | – | – | – | – | – | – | – | – | – |
| | Spike target conc. | – | 13 | – | – | – | – | – | – | – | – | – |
| | Percent recovery | – | 162 | – | – | – | – | – | – | – | – | – |

NOTE: See Table 11 for results of duplicate volatile organics analyses for location T6-3.

*Target concentrations shown exclude sample background concentrations.
†Percent recovery computed as follows:
Percent recovery = (found concentration) ÷ (target concentration + mean background concentration).
Background concentrations below detection limits are assumed to be zero.
**Variability in sample background concentrations exceeds spike target concentration. Percent recovery cannot be accurately calculated.

## E-2.0 SAMPLING INSTRUCTIONS FOR TYNDALL AFB

Descriptions of sample containers, preservation methods, and holding times are given in Table E-3. Sampling procedures are outlined below for each analysis group.

### E-2.1 METALS

Metal samples from the wells should be from the first bailer (1 liter). Bottle should be filled to very top if dissolved metals are desired and filtration is not performed immediately.

Filtration should be as follows:

1. Glass fiber filter should be rinsed with 20 to 30 milliliters of 0.5 N $HNO_3$ after being placed in suction apparatus. Discard rinse.
2. Rinse filter with 20 to 30 milliliters of sample. Discard rinse.
3. Filter sample and return to bottle after the bottle has been rinsed with deionized water.
4. For membrane filtration, place filter in apparatus with gridded side up and follow Steps 1 through 3.
5. Samples must be filtered through the 0.45-microgram filter for analytes to be considered dissolved. Filtration through a glass fiber filter reduces "binding" of the membrane filter but may not be needed for samples with a small amount of turbidity.

Preserve metal samples with 2 milliliters of $HNO_3$ per liter (after filtration for dissolved metals), mix, and check pH by pouring a small amount on pH test strip. pH should be less than 2; add more $HNO_3$ if necessary. Refrigeration is not necessary.

### E-2.2 DOC

Bottle should be completely filled to ensure sufficient sample after filtration. Procedure is the same as that for metals except 5 N HCl is used for rinsing and concentrated HCl for preservation. These samples require refrigeration.

Table E-3. Sample Containers, Preservation Methods, and Holding Times

| Parameter | Sample Type | Container/ Volume | Method of Preservation (Filtration, pH, etc.) | Holding Time |
|---|---|---|---|---|
| Oil and grease | W* | Glass, 1 qt. Teflon liner in cap | Conc. $H_2SO_4$ to pH <2, chill to 4°C | 28 days |
| Phenols | W | Glass, 1 qt. | Conc. $H_2SO_4$ to pH <2, chill to 4°C | 28 days |
| Metals | W | Plastic, 4 oz. | Filter, conc. $HNO_3$ to pH <2 | 6 months |
| (dissolved) | S† | Glass, 1 qt. | | |
| TOX | W,S | Glass, 40 ml (2) Teflon septa | No headspace in vial, chill to 4°C | ** |
| DOC | W | Plastic, 4 oz. | Filter, conc. HCl to pH <2, chill to 4°C | 28 days |
| Purgeables | W | Glass, 40 ml (3) Teflon septa | No headspace in vial, chill to 4°C | 14 days |
| Pesticides (DDT) | S | Glass, 1 qt. Teflon liner in cap | Chill to 4°C | Unknown, or not specified by method |

*W = Water
†S = Sediment
**Not specified

Source: U.S. Environmental Protection Agency (EPA). 1982. Technical Additions to Methods for Chemical Analysis of Water and Wastes, Table 1. EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. EPA-600/4-82-055, December 1982.

E-2.3 OIL AND GREASE

Sample bottles should not be filled to top due to nature of analyte. Bottles are 1-liter, amber glass with foil-lined caps. Preserve to a pH less than 2 with concentrated $H_2SO_4$ and refrigerate.

E-2.4 PURGEABLE ORGANICS

This sample should come from the first aliquot of a bailer to prevent the loss of any volatiles. Excess turbulence should be avoided (e.g., bubbling) when filling these bottles for the same reason. Fill bottle to an inverted meniscus, cap, and refrigerate immediately. A small convex dimple in the top of the septum indicates that the bottle is properly filled. There should be no air bubbles present in the bottle. This sample is taken in triplicate in 40-milliliter glass, screw-cap vials with Teflon septa. Preservation is by refrigeration.

E-2.5 TOX

The same procedure is used as for purgeable organics, except samples are taken in duplicate.

E-2.6 TOTAL PHENOLICS

Bottles should not be completely filled in order to leave room for spiking. Preserve to a pH less than 2 with concentrated $H_2SO_4$ using disposable glass pipets. Refrigerate after acidification.

E-2.7 DDT

Samples are taken in 1-quart, wide-mouth glass jars with a Teflon liner in the cap. Samples are preserved by refrigeration.

## E-3.0 TOX BLIND SPIKE SERIES

Inspection of the Tyndall AFB Phase IIb TOX data suggests the presence of a positive interference in the analysis. TOX was reported at concentrations of at least 80 ug Cl/l in all samples analyzed, including samples from zones where there is no evidence of organic halogens being used, spilled, or disposed of (e.g., fuel storage areas). Phone conversations

with EPA personnel responsible for development of the method indicated that the TOX analysis was subject to positive interferences, particularly in samples containing inorganic halides (Dressman, 1984).

In order to explore the possibility of positive interference in the analysis and to determine recoveries for at least one organohalide other than that against which the results are calibrated, 12 samples were prepared as shown in Table E-4. Six samples were prepared in deionized water and six in deionized water with sodium chloride added at a concentration approximately one third that of sea water. Each sample group was spiked with pentachlorophenol (PCP) at three concentrations and 1,1,2-trichloroethane (TCE) at two concentrations. TCE was selected on the basis of its relatively high solubility in water, 0.45 grams per 100 grams at 20°C; and its relatively high boiling point, 113°C at one atmosphere (NIOSH/OSHA, 1981).

Analytical results for the spike series shown in Table E-4 indicate a strong positive interference for PCP spikes in the chloride matrix. Recoveries for these three-spikes ranged from 141 to 383 percent. Recovery on the blank sample was 550 ug Cl/l. These results support the theory of positive interference by inorganic halides in the TOX analysis, though they are not conclusive. Recoveries for PCP spiked into deionized water ranged from 88 to 117 percent and indicate acceptable accuracy in the absence of interferences. However, a value of 20 ug Cl/l (twice the reported detection limit) was reported for the blank deionized water sample.

Recoveries of TCE in deionized water were poor, with values of 22 and 11 percent reported for the low and high spikes, respectively. In the chloride matrix, results were erratic. The low spike seems to indicate a very strong positive interference (539 percent recovery). Recovery for the high spike was only 17 percent. These limited data suggest that the TOX method may show varying responses for organohalides other than PCP, the compound against which the method was calibrated.

Table E-4. Results of TOX Blind Spike Series

| Matrix | Analyte | Spike Concentration (ug Cl/l) | Found Concentration (ug CL/l) | Percent Recovery |
|---|---|---|---|---|
| Deionized water | - | Blank | 20 | - |
| Deionized water | Pentachlorophenol | 49.0 | 50 | 102 |
| Deionized water | Pentachlorophenol | 196 | 230 | 117 |
| Deionized water | Pentachlorophenol | 490 | 430 | 88 |
| Deionized water | 1,1,2-Trichloroethane | 44.5 | 10 | 22 |
| Deionized water | 1,1,2-Trichloroethane | 178 | 20 | 11 |
| Chloride* | - | Blank | 550 | - |
| Chloride | Pentachlorophenol | 49.0 | 160 | 326 |
| Chloride | Pentachlorophenol | 196 | 750 | 383 |
| Chloride | Pentachlorophenol | 490 | 690 | 141 |
| Chloride | 1,1,2-Trichloroethane | 44.5 | 240 | 539 |
| Chloride | 1,1,2-Trichloroethane | 178 | 30 | 17 |

*Chloride matrix consists of 5 grams NaCl in 500 milliliters of deionized water, or 10 grams per liter.

## E-4.0 EXTENDED HOLDING TIMES FOR PURGEABLE ORGANICS

A thorough review of quality control data indicated that holding times for purgeable organics were exceeded. These samples were analyzed between 14 and 28 days after collection. Documentation for the development of methods used for analysis of VOA and VOH was obtained to estimate the effects extended holding times may have on the analytical results (Bellar and Lichtenberg, 1981a,b). The results of holding time/recovery data for organic compounds analyzed in the Tyndall AFB Phase IIb survey are summarized in Table E-5. Table E-5 lists all Phase IIb volatile organics except chloroform and 1,2-dichlorobenzene, neither of which were detected in significant quantities at Tyndall AFB.

Recoveries shown in Table E-5 for VOH analyzed after holding times of at least 26 days range from 85 to 110 percent. The arithmetic mean of these holding times is 94 percent, indicating excellent average recovery of VOH after 26 days. Five compounds account for over 93 percent of total VOH concentrations reported for the Tyndall AFB Phase IIb survey; bromoform, dichlorodifluoromethane, methylene chloride, and 1,1,1-trichloroethane. Recoveries reported for these compounds are 95, 103, 95, 85, and 93 percent, respectively. These data indicate that extension of the holding times to 4 weeks results in only a slight reduction in recovery of VOH and will not affect conclusions drawn from the data. Bromomethane, trans-1,2-dichloropropene, cis-1,3-dichloropropene, and vinyl chloride were analyzed in the method development studies after holding times of 6 days or less. These four compounds were either not detected or detected in very small quantities in the Tyndall AFB Phase IIb survey.

Recoveries reported by Bellar and Lichtenberg (1981a) for VOA analyzed after 14- or 15-day holding times ranged from 100 percent for benzene to 90 percent for xylenes. Recoveries reported for toluene and xylenes after a 1-day holding time were 98 and 94 percent, respectively. No data were reported for holding times in excess of 15 days. Based on this decline noted in recoveries of VOA over a 14-day period, compounds in the

Table E-5. Summary of Holding Time/Recovery Data for Purgeable Organics

| Constituents | No. of Tyndall AFB Phase IIb Samples Detected In | Spike Level (ug/l) | Number of Samples Analyzed | Source of Samples | Holding Time (days) | Mean Recovery After Holding Time (%) |
|---|---|---|---|---|---|---|
| Volatile Halocarbons | | | | | | |
| Bromodichloromethane | 1 | 0.20 | 17 | O | 27 | 100 |
| Bromoform | 1 | 0.20 | 17 | O | 27 | 95 |
| Bromomethane | 1 | 0.40 | 8 | O+T | 2 | 85 |
| Carbon tetrachloride | 0 | 0.20 | 17 | O | 27 | 90 |
| Chlorobenzene | 0 | 0.50 | 9 | O | 26 | 95 |
| Chloroethane | 0 | 0.40 | 20 | O+T | 21 | 93 |
| 2-Chloroethylvinyl ether | 0 | 0.40 | 21 | O+T | 21 | 100 |
| Chloromethane | 0 | 0.40 | 16 | O+T | 21 | 93 |
| Dibromochloromethane | 1† | 0.20 | 17 | O | 27 | 95 |
| 1,3-Dichlorobenzene | 0 | 0.50 | 9 | O | 26 | 89 |
| 1,4-Dichlorobenzene | 0 | 0.50 | 9 | O | 26 | 90 |
| Dichlorodifluoromethane | 3 | 0.40 | 12 | O+T | 27 | 103 |
| 1,1-Dichloroethane | 0 | 0.20 | 17 | O | 27 | 95 |
| 1,1-Dichloroethene | 4 | 0.40 | 18 | O+T | 27 | 88 |
| 1,2-Dichloroethane | 0 | 0.20 | 17 | O | 27 | 110 |
| Trans-1,2-Dichloroethene | 3 | 0.20 | 17 | O | 27 | 95 |
| Cis-1,3-Dichloropropene | 1† | 0.40 | 4 | O+T | 1 | 90 |
| Trans-1,3-Dichloropropene | 0 | 0.40 | 4 | O+T | 1 | 88 |
| Methylene chloride | 8 | 0.20 | 17 | O | 27 | 85 |
| Tetrachloroethene | 0 | 0.20 | 17 | O | 27 | 90 |
| 1,1,1-Trichloroethane | 8 | 0.40 | 20 | O+T | 21 | 93 |
| 1,1,2-Trichloroethane | 1† | 0.40 | 15 | O+T | 27 | 95 |
| 1,1,2,2-Tetrachloroethane | 0 | 0.40 | 18 | O+T | 21 | 95 |
| Trichloroethene | 0 | 0.20 | 17 | O | 27 | 94 |
| Trichlorofluoromethane | 2 | 0.40 | 21 | O+T | 27 | 90 |
| Vinyl chloride | 0 | 0.20 | 12 | O | 6 | 110 |
| Volatile Aromatics | | | | | | |
| Benzene | 5 | 0.40 | 6 | O | 14 | 100 |
| Ethyl benzene | 2 | 0.40 | 7 | D | 15 | 93 |
| Toluene | 2 | 0.40 | 6 | O | 14 | 95 |
| Xylenes | 3 | 0.40 | 7 | D | 15 | 90 |

*O = Ohio River water, T = carbon filtered tap water, O+T = some samples of Ohio River water and some of carbon filtered tap water, D = chlorinated drinking water.

†The compounds dibromochloromethane, cis-1,3-dichloropropene, and 1,1,2-trichloroethane coelute using these methodologies and cannot be differentiated. The total concentration for the sum of these three compounds was 3 ug/l in one sample at Tyndall AFB.

Source: Bellar and Lichtenberg, 1981a, b.

Notes: 1. Samples were not acidified and were preserved at 4°C.

2. Either sodium thiosulfate or sodium sulfite was added to some samples of carbon-filtered tap water and chlorinated drinking water to inhibit formation of trihalomethanes.

samples should be present after 28 days. VOA data for Tyndall AFB zones fall into two categories: almost none detected at Zones 3 and 7, and significant quantities detected in Zone 6. Some loss of VOA compounds from these samples, even if as great as 50 percent of original concentrations, will not affect the conclusions drawn in the Phase IIb report for these three zones.

## APPENDIX E
## REFERENCES

Bellar, T.A. and J.J. Lichtenberg. 1981a. The Analysis of Aromatic Chemicals in Water by the Purge and Trap Method (Method 503.1). Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. EPA No. 600/4-81-057.

Bellar, T.A. and J.J. Lichtenberg. 1981b. The Determination of Halogenated Chemicals in Water by the Purge and Trap Method (Method 502.1). Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. EPA No. 600/4-81-059.

Dressman, R.C. 1984. Personal communication. Organics Control-Chemical Studies Section, Drinking Water Research Division. U.S. Environmental Protection Agency, Cincinnati, Ohio.

National Institute for Occupational Safety and Health (NIOSH) and Occupational Safety and Health Administration (OSHA). 1981. Occupational Health Guidelines for Chemical Hazards. NIOSH Publication No. 81-123. U.S. Government Printing Office, Washington, D.C.

# APPENDIX F

# CHAIN OF CUSTODY FORMS

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

# CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker, J--

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | | | DDT3 | 15165 | DDT Residues |
| | | | | | | DDT4 | 15166 | |
| | | | | | | DDT5 | 15167 | |
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| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: P. D. Saun Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: D. White T.S.I. | 12/6 1:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.O. Baker, J—

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | X | | | 15146 | Volatile Aromatics |
| | | | | | | | 15150 | " Halocarbons |
| | | | | | | | 15151 | |
| | | | | | | | 15152 | |
| | | | | | | | 15153 | |
| | | | | | | | 15154 | |
| | | | | | | | 15155 | |
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| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: R.D. Saw... Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: T.S.I. D White | 12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

**CHAIN OF CUSTODY RECORD**

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker Jr.

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | | | MS 4 | 15165 | Total Fe Zn Cr Pb Ni Cd |
| | | | | | | MS 6 | 15166 | |
| | | | | | | MS3 | 15167 | |
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| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Organization: P.D. [signature] | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: T.S.I. D. White | 12/4 1400 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

| | |
|---|---|
| CLIENT: Tyndall<br>PROJECT: | SAMPLERS: (Signature)<br>W.A.R. / R.D. Baker, Jr. -- |

| Station Number | Station Location | Date | Time | Sample Type and No. | | | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | Water | Air | Sediment | | |
| | | | | X | | | 15124 | TOC |
| | | | | | | | 15125 | (Field Filtered, |
| | | | | | | | 15126 | w/ HCl, pH <2) |
| | | | | | | | 15127 | |
| | | | | | | | 15128 | |
| | | | | | | | 15129 | |
| | | | | | | | 15130 | |
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| | | | | | | | 15138 | |

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|---|---|---|
| Relinquished by: R.D. Sacco<br>Organization: | Received by:<br>Organization: | Date/Time |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | Date/Time |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | Date/Time |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | Date/Time |
| Relinquished by:<br>Organization: | Received for Laboratory by: T.S.I.<br>D. White | Date/Time<br>12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

CHAIN OF CUSTODY RECORD

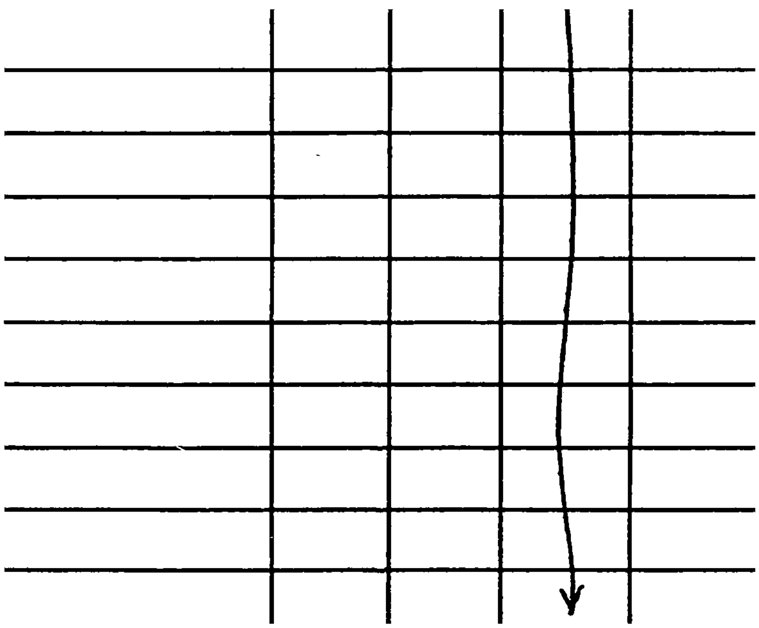
CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker, J.

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | X | | | 15139 | TOC |
| | | | | | | | 15140 | (Field Filtered, |
| | | | | | | | 15141 | w/HCl, pH <2) |
| | | | | | | | 15142 | |
| | | | | | | | 15143 | |
| | | | | | | | 15144 | |
| | | | | | | | 15145 | |
| | | | | | | | 15147 | |
| | | | | | | | 15148 | |
| | | | | | | | 15149 | |
| | | | | | | | 15150 | |
| | | | | | | | 15151 | |
| | | | | | | | 15152 | |
| | | | | | | | 15153 | |
| | | | | | | | 15154 | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: P.D. Sauer<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: T.S.I. D White | 12/6 4:00 |

Method of Shipment: CO. COURIER



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P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

CLIENT: ~~Tynd~~ Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker, J--

| Station Number | Station Location | Date | Time | Sample Type and No. | | | WAR Sample No. | Analysis Required ON ALL |
|---|---|---|---|---|---|---|---|---|
| | | | | Water | Air | Sediment | | |
| | | | | X | | | 15124 | Phenolics |
| | | | | | | | 15125 | (preserved w/ |
| | | | | | | | 15126 | $H_2SO_4$, $pH < 2$) |
| | | | | | | | 15127 | |
| | | | | | | | 15128 | |
| | | | | | | | 15129 | |
| | | | | | | | 15130 | |
| | | | | | | | 15131 | |
| | | | | | | | 15132 | |
| | | | | | | | 15133 | |
| | | | | | | | 15134 | |
| | | | | | | | 15150 | |
| | | | | | | | 15151 | |
| | | | | | | | 15152 | |
| | | | | | | | 15153 | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: P.D. Saw[illegible] Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: T.S.I. D. White | 12/6 1400 |

Method of Shipment: CO. COURIER

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**Water and Air Research, Inc.**
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P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker, J--

| Station Number | Station Location | Date | Time | Sample Type and No. | | | WAR Sample No. | Analysis Required ON ALL |
|---|---|---|---|---|---|---|---|---|
| | | | | Water | Air | Sediment | | |
| | | | | X | | | 15135 | Oil + Grease |
| | | | | | | | 15136 | by IR |
| | | | | | | | 15137 | (preserved w/ |
| | | | | | | | 15138 | HCl, pH <2) |
| | | | | | | | 15139 | |
| | | | | | | | 15140 | |
| | | | | | | | 15141 | |
| | | | | | | | 15142 | |
| | | | | | | | 15143 | |
| | | | | | | | 15144 | |
| | | | | | | | 15145 | |
| | | | | | | | 15169 | |
| | | | | | | | 15170 | |
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| | | | | | | | | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: R.D. Saco<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: D White T.S.I. | 12/6 4:00 |

Method of Shipment: CO. COURIER

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P.O. Box 1121
Gainesville, Florida 32602

CHAIN OF CUSTODY RECORD

preserved w/ $HNO_3$ pH < 2

| CLIENT: Tyndall<br>PROJECT: | SAMPLERS: (Signature)<br>W.A.R./R.D. Baker, Jr. | Need Total Metals As Indicated |
|---|---|---|

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | X | | | 15155 | Pb, only |
| | | | | | | | 15156 | |
| | | | | | | | 15157 | Pb, Zn Cr |
| | | | | | | | 15158 | |
| | | | | | | | 15159 | Pb, only |
| | | | | | | | 15160 | |
| | | | | | | | 15161 | |
| | | | | | | | 15162 | |
| | | | | | | | 15163 | |
| | | | | | | | 15164 | |
| | | | | | | | 15168 | Fe Zn Cr Pb Ni Cd |
| | | | | | | | ~~15164~~ | |
| | | | | | | | 15169 | Pb Only |
| | | | | | | | 15171 | Pb + Cr |
| | | | | | | | 15172 | Pb Only |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: R.D. Baker<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: T.S.I.<br>D. White | 12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

CHAIN OF CUSTODY RECORD

preserved w/ $HNO_3$ pH<2

| CLIENT: Tyndall PROJECT: | SAMPLERS: (Signature) W.A.R. / R.D. Baker | Need Total Metals As Indicated |
|---|---|---|

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 15124 | Fe Zn Cr Pb Ni Cd |
| | | | | | | | 15125 | |
| | | | | | | | 15126 | |
| | | | | | | | 15127 | |
| | | | | | | | 15128 | |
| | | | | | | | 15129 | |
| | | | | | | | 15130 | |
| | | | | | | | 15131 | |
| | | | | | | | 15132 | |
| | | | | | | | 15133 | |
| | | | | | | | 15134 | |
| | | | | | | | 15135 | Pb only |
| | | | | | | | 15136 | |
| | | | | | | | 15137 | |
| | | | | | | | 15138 | |

| Relinquished by / Organization: | Received by / Organization: | Date/Time |
|---|---|---|
| Relinquished by: P.D. S[illegible] Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: T.S.I. D. White | 12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

preserved w/ $HNO_3$ pH <2

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R.D. Baker

Need Total Metals As Indicated

| Station Number | Station Location | Date | Time | Sample Type and No. | | | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | Water | Air | Sediment | | |
| | | | | X | | | 15139 | Pb only |
| | | | | | | | 15140 | |
| | | | | | | | 15141 | |
| | | | | | | | 15142 | |
| | | | | | | | 15143 | |
| | | | | | | | 15144 | |
| | | | | | | | 15145 | |
| | | | | | | | 15147 | Pb + Cr |
| | | | | | | | 15148 | |
| | | | | | | | 15149 | |
| | | | | | | | 15150 | Pb only |
| | | | | | | | 15151 | |
| | | | | | | | 15152 | |
| | | | | | | | 15153 | |
| | | | | | | | 15154 | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Organization: P.A. Sano | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: T.S.I. D White | 12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

preserved w/ $HNO_3$ pH<2

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) W.A.R. / R. D. Baker, J.

Need Total Metals As Indicated

| Station Number | Station Location | Date | Time | Sample Type and No.: Water | Air | Sediment | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | X | | | 15173 | Pb only |
| | | | | | | | 15174 | Fe Zn Cr Pb Ni Cd |
| | | | | | | | 15175 | Pb only |
| | | Does Not Exist | | | | | 15176 | |
| | | | | | | | 15177 | Pb ONLY |
| | | | | | | | [illegible] | |
| | | | | | | | 15178 | Pb + Cr |
| | | | | | | | 15179 | Fe Zn Cr Pb Ni Cd |
| | | | | | | | | |
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| Relinquished by: | Received by: | Date/Time |
|---|---|---|
| Relinquished by: P. W. Sano<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: T.S.I. DeWhite | 12/6 4:00 |

Method of Shipment: CO. COURIER

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

## CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature)
RDB W.A.R., INC.

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required ON ALL |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 2472 | 15162 | TOX |
| | | | | | | 2473 | 15163 | |
| | | | | | | 2474 | 15164 | |
| | | | | | | 2475 | 15168 | |
| | | | | | | 2476 | 15169 | |
| | | | | | | 2477 | 15170 | |
| | | | | | | 2478 | 15171 | |
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| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Robert D. Baker, Jr.<br>Organization: W.A.R., INC. | Received by: FEDERAL EXPRESS<br>Organization: | 12/6/83 4 PM |
| Relinquished by:<br>Organization: | Received by: Rand Potter<br>Organization: UBTL | 12/7/83 10 AM |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: | |

Method of Shipment: FEDERAL EXPRESS

**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

CHAIN OF CUSTODY RECORD

| CLIENT: Tyndall<br>PROJECT: | SAMPLERS: (Signature)<br>RDB W.A.R., INC. |
|---|---|

| Station Number | Station Location | Date | Time | Sample Type and No. | | | WAR Sample No. | Analysis Required |
|---|---|---|---|---|---|---|---|---|
| | | | | Water | Air | Sediment | | |
| | | | | | | | 15165 | TOX |
| | | | | | | | 15166 | (sediment |
| | | | | | | | 15166 | samples) |
| | | | | | | | 15178 | |
| | | | | | | | | |
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| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Robert D. Baker Jr.<br>Organization: W.A.R., INC. | Received by: FEDERAL EXPRESS<br>Organization: | 12/6/83 4PM |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received by:<br>Organization: | |
| Relinquished by:<br>Organization: | Received for Laboratory by: | |

Method of Shipment: FEDERAL EXPRESS

DRAFT FOR REVIEW ONLY

Water and Air Research, Inc.
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602

CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) RDB W.A.R.

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required ON ALL |
|---|---|---|---|---|---|---|---|---|
| | | | | | CE | 2457 | 15139 | TOX |
| | | | | | | 2458 | 15140 | |
| | | | | | | 2459 | 15141 | |
| | | | | | | 2460 | 15142 | |
| | | | | | | 2461 | 15143 | |
| | | | | | | 2462 | 15144 | |
| | | | | | | 2463 | 15145 | |
| | | | | | | 2464 | 15147 | |
| | | | | | | 2465 | 15148 | |
| | | | | | | 2466 | 15149 | |
| | | | | | | 2467 | 15157 | |
| | | | | | | 2468 | 15158 | |
| | | | | | | 2469 | 15159 | |
| | | | | | | 2470 | 15160 | |
| | | | | | | 2471 | 15161 | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Robert D. Baker Organization: W.A.R., INC. | Received by: FEDERAL EXPRESS Organization: | 12/6/83 4 PM |
| Relinquished by: Organization: | Received by: Rand Potter Organization: UBTC | 12/7/83 10 AM |
| Relinquished by: Organization: | Received by: Organization: | Date/Time |
| Relinquished by: Organization: | Received by: Organization: | Date/Time |
| Relinquished by: Organization: | Received for Laboratory by: | Date/Time |

Method of Shipment: FEDERAL EXPRESS

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**Water and Air Research, Inc.**
6821 S.W. Archer Road
P.O. Box 1121
Gainesville, Florida 32602 904-372-1500

## CHAIN OF CUSTODY RECORD

CLIENT: Tyndall
PROJECT:

SAMPLERS: (Signature) RDB W.A.R., INC.

| Station Number | Station Location | Date | Time | Sample Type and No. Water | Air | Sediment | WAR Sample No. | Analysis Required ON ALL |
|---|---|---|---|---|---|---|---|---|
| | | | | | CE | 2442 | 15124 | TOX |
| | | | | | | 2443 | 15125 | |
| | | | | | | 2444 | 15126 | |
| | | | | | | 2445 | 15127 | |
| | | | | | | 2446 | 15128 | |
| | | | | | | 2447 | 15129 | |
| | | | | | | 2448 | 15130 | |
| | | | | | | 2449 | 15131 | |
| | | | | | | 2450 | 15132 | |
| | | | | | | 2451 | 15133 | |
| | | | | | | 2452 | 15134 | |
| | | | | | | 2453 | 15135 | |
| | | | | | | 2454 | 15136 | |
| | | | | | | 2455 | 15137 | |
| | | | | | | 2456 | 15138 | |

| Relinquished by / Organization | Received by / Organization | Date/Time |
|---|---|---|
| Relinquished by: Robert O. Bailey Jr. Organization: W.A.R. INC. | Received by: FEDERAL EXPRESS Organization: | 12/6/83 4 PM |
| Relinquished by: Organization: | Received by: Rand Atten Organization: WBTL | 12/7/83 10:00 AM |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received by: Organization: | |
| Relinquished by: Organization: | Received for Laboratory by: | |

Method of Shipment: FEDERAL EXPRESS

# APPENDIX G

# RESUMES OF PROJECT STAFF

JAMES H. SULLIVAN, JR., Ph.D., P.E.

CHEMICAL ENGINEER
WATER AND AIR RESEARCH, INC.

## Relevant Experience

Dr. Sullivan has played major roles in projects involving technical work directly related to groundwater monitoring and assessment at hazardous wastes sites. His recent experience includes work for a paper manufacturer, a phosphate plant, a landfill, and a cement manufacturer.

Dr. Sullivan directed preparation of Part A and Part B permit applications for the U.S. Navy. He has also worked directly on other projects related to RCRA groundwater monitoring and assessment programs and the permitting process. He is familiar with the DOD Hazardous Materials Information System which he has used to assess chemical/physical properties of DOD compounds. He directed a team of scientists and engineers working at two installations on initial assessment studies (IASs) for the U.S. Naval Energy and Environmental Support Activity (NEESA). Potential for contamination from past hazardous waste disposal was determined for approximately 80 candidate disposal sites. Recommendations for confirmation or remedial action were developed.

At U.S. Air Force bases he conducted Phase 2 Confirmation Studies of potential contamination from past hazardous waste disposal activities. He participated in field work and used field data to assess pollutant movement and severity of contamination. He recommended remedial measures and specified additional data needs for remedial design.

He directed a series of studies for the U.S. Army in which impacts of munitions wastes at several ammunition plants were defined. Siting of a new munitions plant was the objective of another study, and developing water quality criteria for hazardous substances using field and laboratory data was accomplished in another study. He conducted field work, data reduction, report preparation and briefings.

At a U.S. Army installation (Redstone Arsenal), Dr. Sullivan directed a nationally prominant study of environmental contamination from DDT. He was responsible for devising and evaluating engineering techniques for remedial action. The project involved several public agencies, with field data collected by four separate groups. He was responsible for reducing and interpreting all field data. Again he participated directly in field reconnaissance, records research, data compilation, data reduction, report writing, and briefings, including those before Congressional staffs.

Dr. Sullivan studied three solid waste disposal sites near Charleston, South Carolina and monitored groundwater impacts. In addition to gathering chemical data on groundwater and soils, fluorescent dye was used to trace groundwater movement. Evidence of hazardous substances in leachate was found and remedial action recommended.

## Education

| | | |
|---|---|---|
| Ph.D. | Environmental Engineering | University of Florida |
| M.S. | Environmental Engineering | University of Florida |
| B.S. | Chemical Engineering | Georgia Institute of Technology |

## Professional Registrations and Society Memberships

Professional Engineer--Florida
Member of 8 professional societies

## Publications

Author and co-author of approximately 10 publications and 45 technical reports in water chemistry, potable water treatment, wastewater renovation, and environmental impact assessment.

**WILLIAM G. THIESS**

**ENVIRONMENTAL ENGINEER**
**WATER AND AIR RESEARCH, INC.**

## Relevant Experience

Mr. Thiess has worked with hazardous waste management at facilities in Georgia, Florida, Alabama, and Texas. He prepared major portions of a Part B application for a commercial treatment, storage, and disposal facility in Georgia. He developed concept designs for container storage and sludge fixation (solidification) facilities. He developed all topographic information and process descriptions, and he designed plans for waste storage and handling.

Mr. Thiess prepared major portions of a Part B application for a Naval Air Station in Texas. He helped develop plans and specifications for a container storage building and vaulted, below-grade storage tanks. He prepared detailed facility descriptions. He has interfaced directly with permit agency staff to negotitate permit conditions.

Mr. Thiess has participated in initial assessment studies (IASs) of hazardous waste contamination at U.S. Marine Corps and U.S. Navy installations. For a naval shipyard, he was also responsible for developing recommendations for further groundwater assessment and remedial actions where contamination was apparent.

Mr. Thiess evaluated engineering alternatives for isolation or detoxification of DDT-contaminated sediments near Huntsville, Alabama. His primary role in this project was to select, design, and cost various mitigation alternatives. He also helped evaluate relative alternative effectiveness.

In another groundwater contamination study near Redstone Arsenal (Alabama), he supervised well sampling and laboratory analysis of hazardous organics according to rigid field and laboratory procedures.

For the U.S. Army Corps of Engineers (COE), Mobile District, he directed efforts to identify and assess impacts upon physical systems for the Coosa River Navigation Project environmental impact statement. For Savannah District, he supervised and participated in field work and data analysis for the Richard B. Russell Dam pre-impoundment study.

He has participated in and directed portions of Section 208 projects in central Florida. He developed water and nutrient budgets for the Winter Haven chain of lakes in a study designed to evaluate restoration alternatives for Lake Howard. He was also responsible for design and implementation of a study to evaluate effects of septic tank drainfields on water quality in three central Florida lakes.

While a graduate research assistant at Clemson University (1978-1979), he was responsible for organizing and directing stream survey field work for a project sponsored by the U.S. Environmental Protection Agency (EPA) designed to evaluate the effectiveness of control measures for nonpoint source pollutants. He supervised laboratory work in sediment transport analysis and applied various digital computer models to drainage basins for erosion and sediment transport analysis. He dealt with various state and federal agency personnel, as well as local interests, during organization and implementation of the project.

## Education

| | | |
|---|---|---|
| M.S. | Environmental Engineering | Clemson University |
| B.S. | Environmental Engineering | Florida Institute of Technology |

## Professional Organizations

Chi Epsilon
Water Pollution Control Federation
American Water Works Association

JERRY A. STEINBERG, Ph.D., P.E. — WATER RESOURCES ENGINEER
WATER AND AIR RESEARCH, INC.

## Relevant Experience

Dr. Steinberg is an environmental engineer specializing in the management of hazardous wastes and defining pollutant transport. This includes working at abandoned sites, writing hazardous waste management plans, and preparing hazardous waste facility permits. He has worked directly with regulatory agency staff to negotiate types and amounts of information required and compliance schedules on Part B permits.

For the U.S. Navy he conducted hazardous waste inventory surveys at installations in Texas and Florida. He developed hazardous waste management plans for Naval Air Stations at Corpus Christi, Texas; and Pensacola and Jacksonville, Florida. He filed RCRA Part B permit applications for facilities in Georgia, Florida, and Texas. At one or more of these facilities, incinerators, surface impoundments, treatment in tanks, container storage, storage in tanks, and thermal treatment were permitted. Dr. Steinberg has worked on all components for Part B applications. He has developed closure plans, closure costs, preparedness/prevention measures, and contingency plans. Work included developing concept designs for facilities not meeting 40 CFR 264 requirements. Plans for modifying facilities to achieve compliance were developed. He has directed work for the Naval Energy and Environmental Support Activity (NEESA) at three installations assessing environmental contamination potential from hazardous waste disposal. This initial assessment study (IAS) involved bases in Virginia and North Carolina. In addition to directing the project, he actively participated in all technical phases including: archival research, on-site reconnaissance, data assessment, developing recommendations for confirmation or mitigative action, and report preparation.

For the U.S. Air Force, Dr. Steinberg has participated in installation restoration program (IRP) activities at six bases. At bases in Florida and North Carolina, he conducted on-site assessment of confirmation sites. He then developed work scopes for conducting confirmation work. He participated directly in confirmation assessments at bases in Florida and Virginia. Monitoring data were reviewed leading to determination of environmental degradation and the need for remedial actions. For the U.S. Army, he conducted field studies of dispersion of munitions wastes in surface waters at Holston AAP. At Longhorn and Louisiana AAP, he participated in field studies of munitions impacts on ambient water. He conducted pollutant dispersion analysis on the Clinch River (TN) to assess downstream effects of peaking power dam discharges.

In Dade County (FL) he assessed groundwater contamination from disposal of a proposed hazardous waste. Wells were sited and installed, sampling directed, and results interpreted. Evidence of pollutant movement beyond property boundaries was shown; however, hazardous constituents did not migrate far in the aquifer. Mitigation recommendations were made.

Dr. Steinberg has prepared comments for submission to the U.S. Environmental Protection Agency (EPA) addressing technical appropriateness of federal hazardous waste regulations. He has participated in EPA-sponsored workshops on Part B application filing. He has drafted two major American Society of Civil Engineers (ASCE) hazardous waste policy statements which have been presented to U.S. congressional committees. He is chairman of the ASCE Hazardous Waste Management Committee.

## Education

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| Ph.D. | Environmental Engineering | University of Florida |
| M.S.E. | Water Resources Engineering | Vanderbilt University |
| B.C.E. | Civil Engineering | Vanderbilt University |

## Professional Registrations and Societies

Professional Engineer--Florida
American Society of Civil Engineers
American Water Resources Association
American Geophysical Union (Hydrology Section)

ROBERT D. BAKER, JR.

**ENVIRONMENTAL CHEMIST**
**WATER AND AIR RESEARCH, INC.**

## Relevant Experience

Mr. Baker is a highly skilled organic chemist who has diverse experience in analyzing environmental samples for various organic constituents. Examples of his recent work include:

- o Gas chromatographic (GC) analysis using FID, ECD, NPD, FPD, and Hall ECD and high-pressure liquid chromatographic (HPLC) analysis using variable wavelength UV/visible, fluorescence, and electrochemical detectors; and

- o Developing and testing methods for analysis for determining trace levels of organic contaminants in pesticide industry wastestreams, which included, among other analyses, detecting phenolics and volatiles using GC.

In work related to other pesticide manufacturers, he reviewed and assessed processes for more than 200 compounds. Using plant operating data, he identified possible impurities introduced through raw materials, by-products created from side-reactions, and potential contamination from various solvent media. This work ultimately led to development of pretreatment technologies.

Mr. Baker modified existing methods of analyzing for DDT in natural waters. Modification was necessary to meet extremely low detection limits with rigorous quality control because of low concentrations mandated in drinking water regulations.

Other types of analytic work by Mr. Baker include:

- o Analyzing natural water (river and lake) samples for organics for background EIS data--Georgia, South Carolina, Alabama, and Florida;

- o Analyzing water and sediment samples for low levels of DDT, PCBs, and other organics--Alabama and Virginia;

- o Developing improved techniques to accurately measure volatile hydrocarbon levels in soils--Virginia;

- o Analyzing fish tissue for hazardous waste contamination in blinded samples with better than 90-percent accuracy on duplicates and controls--Alabama;

- o Using HPLC to verify methods for analysis of 16 polynuclear aromatic hydrocarbon compounds and 2 benzidine compounds (wastewater matrix)--Ohio; and

- o Using HPLC to develop methods and analyze for hazardous (munitions) wastes--Louisiana and Texas.

## Education

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| B.S. | Chemistry | Northeast Louisiana University |

## Professional Societies

American Chemical Society
American Association for the Advancement of Science

**CHARLES R. FELLOWS** **ENVIRONMENTAL CHEMIST**
**WATER AND AIR RESEARCH, INC.**

## Relevant Experience

Mr. Fellows is an environmental chemist trained in both field studies and formal laboratory chemistry.

As a member of hazardous waste site investigation teams, Mr. Fellows has conducted interviews regarding past disposal practices, past and present industrial/chemical processes, and the chemical and physical nature of disposed materials. On several occasions he has identified waste sites that posed an immediate concern to human health.

Mr. Fellows is familiar with and has used various appropriate safety procedures and techniques while sampling sites that have received hazardous wastes. He has collected groundwater, surface water, sediment, and leachates for a wide variety of organic, inorganic, and physical analyses. He is experienced in applying site assessment models to evaluate migration and health-threatening potential of chemical wastes at specific disposal sites.

In addition to the procedures mentioned above for collection, preservation, and analysis of various types of samples, he is familiar with the RCRA EP Toxicity Test Procedure, the U.S. Army Corps of Engineers Elutriate Test Procedure, and groundwater monitoring procedures for arsenic, heavy metals and other toxicants.

Mr. Fellows is directly responsible for inorganic chemical analyses. He performs quality assurance checks and often participates in actual laboratory water quality analyses. He recently worked with an industry generating hazardous wastes to develop suitable extraction methods for assessing waste toxicity. He helped to develop wastewater analysis protocols which mitigated interferences from chemicals in battery manufacturing wastes.

He directs sampling of groundwater monitoring wells and participates in developing field sampling networks for both surface waters and groundwaters.

## Education

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| M.S. | Water Chemistry | University of Florida |
| B.S. | Biology | Eckerd College |

## Publications

Author and co-author of several articles and technical reports

WILLIAM D. ADAMS

HYDROGEOLOGIST
WATER AND AIR RESEARCH, INC.

## Relevant Experience

Mr. Adams is a graduate geologist who has specialized in engineering applications of hydrogeology. His practical experience is strongly oriented toward solving problems of pollutant transport in the subsurface environment.

He works on environmental contamination assessments and hazardous waste management/ permitting. He has conducted hydrogeologic work at abandoned hazardous waste sites at DOD installations in Alabama, Florida, North Carolina, Georgia, Virginia, and Arizona. At some of these bases, chemical agent disposal was investigated and elaborate health and safety precautions were used.

His project responsibilities have included: assembling and reviewing geologic and geohydrologic literature; quantifying pollutant movement potential using published documents and/or field test data; supervising monitoring well installation; selecting well sites, depths, and casing requirements; specifying rig clean-up procedures; and drafting reports of findings for DOD and regulatory staffs. Mr. Adams has also participated in staff briefings detailing interim and final findings.

He conducted a comprehensive hazardous waste inspection and survey at Pensacola Naval Air Station. Industrial facilities which generate substantial quantities of various wastes were visited and associated personnel debriefed to determine waste generation and handling practices. This information was used in two ways. First, Mr. Adams and his team developed a complete hazardous waste management plan for the entire complex. This ensured compliance with 40 CFR 260-265. A Part B permit application, including revised Part A, was then filed. Facilities permitted included container storage buildings, surface impoundments, and treatment in drying beds. A preliminary design for additional container storage was reviewed and concept design modifications made to ensure RCRA compliance (40 CFR 264). Although numerous tanks were used, all tank usage was reviewed and recommendations were made to alter hazardous waste storage practices. This eliminated the need to permit any tank.

Mr. Adams has also directed field work for installation restoration confirmation studies (Phase 2) at Langley Air Force Base, Virginia and Eglin Air Force Base, Florida. In these studies, he researched site geology, sited all wells, supervised well installation and development, and collected samples for inorganic and organic constituent analyses.

In another DOD study, Mr. Adams compared two potential depleted uranium burial sites. He planned and supervised the field work, lab work, and report preparation. An important aspect of this study was assessing potential routes of contaminant migration. This work included extensive field and laboratory soils testing and analysis.

## Education

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| M.S. | Geology | University of Florida |
| B.S. | Geology | University of Florida |

## Professional Societies

National Water Works Association
Florida Water Well Association

## Publications

Author and co-author of several articles and technical reports.

**APPENDIX H**

**SAFETY PLAN**

APPENDIX H

SAFETY PLAN

## H-1.0 GENERAL

The safety plan presented herein gives guidelines for basic safety procedures and equipment utilized by WAR during the course of IRP Phase II surveys. Samples collected during Phase II surveys are typically environmental water and sediment samples as opposed to hazardous waste samples and normally do not require unusual levels of personnel protection. Detailed procedures and equipment required to minimize exposure to specific hazardous wastes or conditions requiring higher levels of protection are beyond the scope of this plan. References are provided from which waste-specific information on equipment and procedures can be obtained on a case-by-case basis.

## H-2.0 INFORMATION REVIEW

Prior to initiating Phase II survey field work, the Phase I records search is reviewed in detail to identify hazardous wastes or conditions that may be encountered at each site. Available toxicological data on materials suspected of being present at the sites are reviewed to determine if the base level of personnel protection outlined in Section H-5.0 is adequate. Hazards such as the presence of highly toxic or incompatible chemicals, toxic gases, radioactive material, or explosives may require more extensive precautionary measures than the base level of protection. Safety hazards requiring special attention are addressed on an individual basis using appropriate assessment methods and equipment and procedure recommendations given in the EPA Field Health and Safety Manual (EPA, 1980) and the EPA Safety Manual for Hazardous Waste Site Investigations (EPA, 1979). Hazardous conditions can be clarified or confirmed on preliminary site visits.

## H-3.0 MEDICAL MONITORING PROGRAM

The person responsible for Phase II survey field work will determine whether a medical monitoring program is necessary, based on results of the information review. If hazard levels are judged high enough to

warrant this procedure, all field personnel will participate in a medical monitoring program. Guidelines for the program are given in Appendix I of the EPA Field Health and Safety Manual (EPA, 1980).

## H-4.0 FIELD PERSONNEL INDOCTRINATION

All field personnel will be informed by the project field supervisor of required safety equipment and procedures prior to on-site work. Subjects covered will include personal safety gear, general and site-specific safety procedures, and incident notification procedures.

## H-5.0 PERSONNEL PROTECTION GEAR

The following items will be provided on-site for all field personnel:

- Tyvek® disposable coveralls
- Rubber boots
- Rubber gloves
- Hard hats
- Eye protection (safety glasses or face shields).

Hearing protection (disposable ear plugs) will be provided for all work in the vicinity of the flight line or other noise hazards. Cartridge-type respirators will be available on-site for protection against inhalation of dust or vapors. If strong vapors are encountered, respirators will be utilized to facilitate evacuation of personnel and equipment from the site until the situation can be assessed or corrected.

Personal equipment described above will offer adequate protection for most situations encountered during the course of Phase II survey field work. When conditions are identified that require a higher level of personnel protection, the EPA Safety Manual for Hazardous Waste Site Investigations will be referred to for guidance.

## H-6.0 SAFETY PROCEDURES

Hard hats and eye protection will be worn when appropriate, as directed by the project field supervisor. Protective clothing (boots, gloves,

and coveralls) will be worn at all times while working on-site. Coveralls will be changed a minimum of once daily.

The project field supervisor will consult with the base environmental coordinator or other responsible contact regarding site-specific hazards prior to entering sites. Special procedures for entering and working at particular sites will be clarified and conveyed to all field personnel. Examples of areas requiring strict procedures are active runways or taxiways, fuel handling or storage areas, and secure areas.

Prior to any drilling or digging on the sites, USAF Form 103 must be routed to all applicable base organizations for a clearance review. Circulation of this form is required to avoid contact with underground or overhead utilities, conflict with base activities, or breaches of security.

Additional safety procedures will be implemented, if warranted by the information review or conditions encountered at the site. Site-specific safety procedures will be based on guidelines given in the <u>EPA Field Health and Safety Manual</u> and the <u>EPA Safety Manual for Hazardous Waste Site Investigations</u>.

## H-7.0 INCIDENT/ACCIDENT NOTIFICATION PROCEDURES

At a minimum, the following emergency phone numbers should be available on-site:

1. Ambulance or medical assistance,
2. Base fire department (or other if off-site), and
3. USAF contact for project.

After contacting appropriate emergency services (if necessary), the USAF project contact should be notified of the incident or accident so that it can be dealt with according to base policies and procedures.

## References

U.S. Environmental Protection Agency (EPA). 1979. Safety Manual for Hazardous Waste Site Investigations. EPA National Enforcement Investigations Center, Denver, Colorado.

U.S. Environmental Protection Agency (EPA). 1980. Field Health and Safety. EPA Region 4, Atlanta, Georgia.

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